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THE DIFFERENTIAL MEASUREMENT OF SPEED IN PRIMARY SCHOOL CHILDREN

AILEEN CARPENTER[1]

Extensive investigations have been carried on concerning the motor ability and motor development of babies and preschool children but very little has been done with the same children once they have entered the first grade. The primary grades seem to have been left completely out of the picture. Later, at about the fourth grade level, interest in the child's physical abilities and capacities seems again to be shown by research workers. But what has been happening to these children in the meantime?

The study herein reported is part of a larger investigation involving several factors of motor ability and capacity (1). This report is concerned chiefly with an investigation of measurements of big muscle speed of children in the first, second, and third grades. Records were obtained for 128 boys and 125 girls of the first three grades and from these the following fourteen events were included in this study.

1 and 2. Right and left grips are taken in the usual manner by means of a Smedley hand dynamometer (3). The children were urged to exert their maximum strength.

3. The broad jump is taken from a stand and according to standard directions.

4. The 30 yards dash is taken from a regular start. Score is time in seconds and tenths.

5. In "run and over" the child runs 25 feet, climbs or vaults over a wooden carpenter's "horse" two feet high and four feet long, turns around the horse and runs back. A running start is used. The score is the time in seconds and tenths from the moment the child crosses the starting line until he recrosses it.

6. In "run and under" the child runs 25 feet, rolls or scrambles under the wooden "horse" described above, turns around the horse and runs back. A running start is used. It is scored the same as No. 5.

7. In "run and sit" the child runs 25 feet, sits down on the ground or floor, gets up, turns around and runs back. Start and scoring are the same as in No. 5.

8. In "hop" the child hops 50 feet on one foot. A standing start is used. Score is the time in seconds and tenths taken to complete the hopping.

9. The Sargent jump is taken following standard directions and using a wall chart (3).

10. In the baseball distance throw the child uses a 12" playground baseball. His record is the best throw of three trials.

11. In the volleyball distance throw the child uses the regulation volleyball. His record is the best throw of three trials.

12. In baseball accuracy the child stands 10 feet from a target the lower edge of which is 2 feet from the floor. The target is of the same size and coloring as that commonly used in archery, 4 feet in diameter

[1]*From Teachers College of Kansas City, Kansas City, Missouri.*

with the center circle gold, next red, next blue, next black, and outside ring white. The gold scores 9, red 7, blue 5, black 3, and white 1. A 12" ball is used. The score is the total number of points made in five throws. Any type of throw is allowed.

13. For "ball bounce" the child stands in a square 1' x 1'. His score is the number of times he can bounce a 24" rubber playground ball consecutively (up to 50) without stepping out of the square. He is allowed three trials of which the best score is recorded.

14. For "ball catch" the child is allowed ten chances to catch the 12" ball tossed at moderate speed, chest high, by the experimenter who stands 10 feet from the child. The score is the number of times out of ten that the child catches the ball successfully.

Reliabilities were computed for each of these tests. These reliabilities will be found in Table 1.

TABLE 1

RELIABILITIES OF THE TESTS INCLUDED IN THE TWO FACTOR ANALYSES

(Boys and girls combined)	
Right grip	.8247
Left grip	.8193
Broad jump	.8941
Dash	.9082
Run and over	.7890
Run and under	.5902
Run and sit	.8624
Hop	.6235
Sargent jump	.8533
Baseball distance throw	.9969
Volleyball distance throw	.8942
Baseball accuracy	.6411
Ball bounce	.9889
Ball catch	.9843

The means and standard deviations of the tests included in this study are given in Table 2.

The fourteen tests were then intercorrelated, with boys and girls done separately, and factor analyses according to Thurstone's (4) method, with rotations done two at a time, were carried out. The intercorrelations upon which the factor analyses were based are given in Table 3. With this number of cases, correlations carried to four decimals are not, of course, significant to four places. Since rounding them off to two or three decimals frequently leaves one in doubt as to whether the sum of the factor residuals actually approximates zero, it is the author's practice to carry out all computations, even with samples of this size, to four decimals.

It will be noticed that some of the tests included in this group of fourteen are obviously not speed tests, for instance, right and left grips. These are included in order to enable the author to orient the strength and velocity factor axes in the factor analyses. This enables us to be more sure of the identification of the velocity factor as such and to be able to choose the velocity tests which are least complicated by the strength factor. Two factors are outstanding, a third may possibly

TABLE 2

MEANS AND STANDARD DEVIATIONS OF TESTS INCLUDED IN THE TWO FACTOR ANALYSES[2]

	Boys		Girls	
	M	SD	M	SD
Right grip	25.15	8.1240	19.74	7.6975
Left grip	27.97	6.6145	22.70	7.3145
Broad jump	3.72	.8124	2.99	.6519
Dash	6.52	.6892	6.75	.6558
Run-over	9.47	1.2689	9.99	1.2390
Run-under	9.20	.9747	9.95	1.1225
Run-sit	9.00	1.0429	9.57	1.2207
Hop	6.30	1.5133	6.03	1.4892
Sargent jump	21.95	4.7244	20.14	4.5122
Baseball distance throw	39.30	17.833	21.31	9.4075
Volleyball distance throw	20.59	8.4855	11.86	4.6604
Baseball accuracy	26.41	8.5585	15.85	9.2219
Ball bounce	28.95	19.1965	30.5	20.2670
Ball catch	8.91	1.6733	9.98	2.0736

TABLE 3

INTERCORRELATIONS OF VARIABLES INCLUDED IN THE TWO FACTOR ANALYSES*

	1 Right grip	2 Left grip	3 Broad jump	4 Dash	5 Run-over	6 Run-under	7 Run-sit	8 Hop	9 Sarg. jump	10 B.B. dist.	11 V.B. dist.	12 B.B. Acc.	13 B.B.
1. Right grip													
2. Left grip	.7183 .6776												
3. Broad jump	.3971 .2274	.4135 .2151											
4. Dash	.2425 .2788	.4784 .3581	.5759 .4752										
5. Run-over	.1789 .1832	.1443 .1355	.4056 .4172	.4909 .3381									
6. Run-under	.2153 .1441	.2178 .1485	.5211 .3778	.4832 .3191	.5651 .5127								
7. Run-sit	.2730 .1550	.2824 .2335	.3858 .3167	.3396 .3014	.3901 .4980	.4854 .6558							
8. Hop	.3513 .3256	.3716 .3171	.5838 .4904	.4551 .5877	.2558 .4012	.3719 .3729	.4243 .3630						
9. Sarg. jump	.7726 .3632	.4542 .3851	.5469 .4013	.5045 .3747	.3639 .3305	.3831 .3231	.3396 .3550	.4939 .4470					
10. B.B. dist.	.4783 .3887	.5244 .3616	.4411 .3116	.4416 .2448	.2127 .1798	.3167 .2077	.3160 .1808	.4316 .4084	.5544 .2884				
11. V.B. dist.	.3882 .2973	.4166 .3257	.4760 .3574	.3814 .2716	.3023 .2416	.3340 .2518	.3978 .1688	.5043 .4489	.5719 .3409	.6926 .6637			
12. B.B. Acc.	.2543 .1684	.2244 .2088	.3613 .3884	.5595 .3386	.2340 .1383	.2186 .1862	.1905 .2021	.4227 .2997	.1970 .1397	.2688 .2806	.2791 .1586		
13. Ball. bounce	.3579 .2436	.2745 -.0221	.5449 .3800	.4930 .0524	.3134 .2691	.3187 .1824	.2157 -.1006	.3935 .0845	.5218 .3222	.5000 .1573	.4807 .3507	.2961 .2632	
14. Ball catch	.0935 .2960	.1701 .2775	.3259 .2461	.3366 .2171	.1080 .1619	.2346 .0909	.1135 -.0314	.3357 .3281	.5188 .2071	.5367 .3380	.3073 .3103	.2277 .2914	.3954 .2159

*Where the boys' and girls' records are combined in tables, the boys' are underlined.

[2] All of the tests except the grips have been T-scored before being intercorrelated. Hence the correlations of speed events with the other variables are positive rather than negative as they would have been had the raw scores been used.

be identified, but the loadings for a possible fourth were so extremely small for each of the fourteen variables that they were used solely as a residual factor for rotating purposes. Table 4 gives the rotated factor loadings of the two factor analyses.

Factor I can be identified as the Strength Factor with right and left grips measuring strength, as one would expect, to a fairly high degree. Factor II appears identifiable as the Velocity Factor since those tests requiring speed in their performance are most heavily loaded in this factor. The third factor seems to have some relationship to ball handling. It is probably identical with Wendler's "sensory motor coordination" factor (5). Since this factor will not be referred to again in this paper, we shall not discuss it further.

Several multiple correlations were then computed in order to determine which of those tests heavily loaded in Factor II will best predict

TABLE 4

ROTATED FACTOR LOADINGS OF TWO FACTOR ANALYSES

	Factor I	Factor II	Factor III
Right grip	.8743 .8062	-.0605 -.0192	-.0097 .0185
Left grip	.7604 .7225	.0754 .0605	-.0365 -.0255
Broad jump	.4265 .2491	.6238 .5918	.1620 .1521
Dash	.4361 .3324	.6130 .5559	.0281 .0180
Run-over	.2265 .2572	.6248 .6028	-.1349 .0070
Run-under	.2010 .2178	.7352 .6760	-.0555 -.0057
Run-sit	.2882 .2622	.5064 .6361	-.0097 -.0836
Hop	.4179 .3845	.4886 .5965	.2326 .1822
Sargent jump	.6192 .4853	.3490 .4061	.4078 .0387
Baseball distance throw	.6016 .3798	.2555 .1956	.4705 .6049
Volleyball distance throw	.5461 .3018	.3097 .2908	.4202 .6623
Baseball accuracy	.3696 .2209	.2782 .2766	.2314 .3174
Ball bounce	.4366 .2319	.3899 .1426	.3266 .3040
Ball catch	.2410 .3955	.2255 .0538	.5854 .3000

the velocity of the individual. Strength has a small, practically negligible, loading in Factor II but each of the tests which make up the Velocity Factor has a slight degree of strength (as is evidenced by their loadings in Factor I). Because of this, right and left grips were included in some of the multiples.

The computations for boys and for girls were done separately. Table 5 gives the resulting multiple correlations.

TABLE 5

MULTIPLE CORRELATIONS WITH THE VELOCITY FACTOR

0 = Velocity factor
1 = Run and under
2 = Run and sit
3 = Run and over
4 = Hop
5 = Broad jump
6 = Dash
7 = Right grip
8 = Left grip

Girls		Boys	
R 0.124578	.8687	R 0.136478	.8802
R 0.12457	.8680	R 0.13647	.8801
R 0.123456	.8482	R 0.135624	.8275
R 0.12345	.8373	R 0.1364	.8242
R 0.1245	.8268	R 0.13562	.8218
R 0.1234	.8141	R 0.1356	.8162
R 0.124	.7956	R 0.136	.8107
R 0.123	.7622	R 0.135	.8002
R 0.12	.6986	R 0.13	.7777

As is shown in Table 4, the batteries of four correlate almost as highly with the criterion as do those of five and very little less highly than do those of six. Consequently, the two batteries chosen are Run and under, Run and over, Hop, and Dash for the boys, and Run and under, Run and over, Hop and Broad jump for the girls. The two grips added to the batteries increased the correlations notably. Because both grips are ordinarily taken, and two are more reliable than one alone, both are included in the formulae for the prediction of the velocity factor. Unfortunately for simplicity of administration the two batteries are not identical. However, since they will probably be used primarily for research purposes, this is not a serious difficulty. For class use, as well as for research use, all six can be easily given to all of the children, then the records of the four recommended can be used for further study.

Multiple regression equations were computed for both girls and boys to predict the Velocity factor from these variables.[3] They are:

[3]While the major objective of this study has been to develop a measurement of the speed factor for primary children a by-product of the study is a similar measurement of the strength factor. While it must be recognized that the measurement of the grip strength alone is of course a limited measurement of the strength factor, for those wishing to measure this factor as well as is practicable with children of this age, the following regression equations may be utilized. The results, as with the measurement of the Velocity factor, are in one score of which 50 is the average and each 10 above or below the mean represents one standard deviation. The means and standard deviations are given in Table 2.

Girls: R .9052

Strength factor = .6267 R grip + .4765 L grip + 26.36

Boys: R .8957

Strength factor = 1.0248 R grip + .9368 L grip + 12.87

Boys: (R of .8802) Velocity factor = 158.89 - 4.654 Run and under - 1.810 Run and over - 3.814 Dash - 1.723 Hop - .249 right and left grips combined.

Girls: (R of .8687) Velocity factor = 107.54 - 2.717 Run and under - 2.221 Run and sit - 2.267 Hop + 4.482 Standing broad jump in feet - .212 right and left grips combined.

Since a factor has no absolute mean or standard deviation, 50 is taken as the mean and 10 as the standard deviation. If the distributions of samples have been normal this would result in a T-score. Since the distributions are slightly platykurtic the result is simply a score in which 50 is average for this group of children and each 10 above or below the average represents one standard deviation. The results are not essentially different from a T-score but will not correspond to T-score percentiles.

The Velocity factor was computed and correlated with age. The resulting correlation is low but the regression is linear. Since this is true, and the ages are from birthday to birthday instead of the nearest age, there is every reason to believe that standards may be interpolated for the ages 5 and 11. The low correlation makes it evident that the score increases very slowly with age over this age range. Table 6 gives suggested standards for the ages 5 - 11.

TABLE 6

SUGGESTED STANDARDS FOR VELOCITY FACTOR FOR AGES 5 - 11

Age	Girls	Boys
11	58.55	57.44
10	57.15	55.72
9	55.75	53.90
8	54.34	52.28
7	52.94	50.56
6	51.54	48.83
5	50.14	47.11

These batteries are recommended primarily as tools for further research in the area of motor ability and capacity of primary school children. The tests in themselves are fun to do and they can be fitted very satisfactorily into the program of physical education for the lower grades. We are interested in finding out what happens to children as they go along. If they exhibit certain performances in infancy, what will they do at eight? Likewise, what will be the relationship between performances at primary school ages, and those in later years for which test devices are numerous? Our validated tools of measurement in the lower grades are very few so these batteries are recommended as means of measuring the velocity factor for this age group. They will be found especially useful in the research programs of private schools and university laboratory schools where long term programs of investigation are under way. These tests, while not calibrated for the preschool child, can probably be used with confidence at the age of five. However, the enterprising primary grade teacher who is interested in measuring objec-

tively the various capacities and abilities of her children, may find this group of tests a useful means of accomplishing her aims in this particular area.

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SOME PHYSIOLOGICAL CHANGES DURING FRUSTRATION[1]

HUDSON JOST

The purpose of this study was to determine what physiological changes occurred during experimental frustration and to correlate these changes with measures of the individual's adjustive pattern. The measures of physiological changes are most valuable because they give absolute and objective measures of emotional reactions.

The concept of the role of frustration in the determination of behavior, both normal and abnormal, has been accepted by most psychologists. It is generally assumed that frustration is accompanied by physiological tensions and that these tensions are essentially emotional in nature. In normal emotional behavior the tensions, which include visceral and skeletal activity, disappear within a relatively short time, that is, as soon as overt or covert activity re-establishes equilibrium. In situations of frustration, however, the tensions are more severe and prolonged because of the lack of solution of the frustrating problem.

The overt activity of an individual in one situation is determined by his past behavior in similar situations. Physiological activity, on the other hand, is not entirely dependent on past experience; thus it is relatively similar in different individuals. Because of this relative internal consistency, physiological processes are probably a better measure of the individual reactions to frustration than are the more variable overt responses. The tensions resulting from frustration lead to overt or covert activity, but the form of this activity is socially determined. In this respect the physiological tensions are motivators of activity but they do not determine the form of the behavior.

METHODS

The experiment consisted of seven parts. Physiological measurements were made in situations in the following sequence: (1) Rest, (2) Attention, (3) Learning, (4) Frustration, (5) Recall, (6) Rest, and (7) Sensory Stimulation. The rest periods, in which the subjects were instructed to relax, represented basal physiological levels. The attention, learning, recall, and sensory stimulation periods were introduced to obtain further control periods of physiological change. The physiological reactions during frustration were compared with the responses in the control periods.

The subjects were required to learn a sequence of digits by the anticipation method, that is, each number was guessed before it was flashed on a lighted panel. This apparatus consisted of a rectangular box faced with glass on which the digits 1 to 5 could be lighted by the experimenter. The subjects were allowed to learn successfully two series in order to give them feelings of success. Then a series of numbers apparently like the others but too difficult to recall was presented. Frustration occurred when a subject discovered that he could not learn a series which was very similar to the ones he had formerly learned easily.

[1] *The Orthogenic School, University of Chicago.*

The subjects in the experimental group were eighteen children from the Orthogenic School, University of Chicago, representing a cross section of adjustive problems. Two were schizophrenic, five were diagnosed neurotics, and five were behavior problems. Except for the two phychotic children, each of the others had some signs of a neurotic condition. Twenty subjects which represented a control group, from the University Elementary School, were picked for the good adjustment they were making in school and play activities.

The data were analysed in the following three ways. The first consisted of a comparison of the reactions of the experimental and control groups, the second was a detailed analysis of the physiological responses of the experimental group. The third was a factoral analysis of the significant data, which will be published elsewhere with the presentation of further data.

MEASURES

The physiological measures used in this study were chosen because of their general relation to emotionality as indicated by previous work. The seven measures were: (1) Galvanic Skin Resistance, (2) Respiration, (3) Pulse Rate, (4) Blood Pressure, (5) Hand Tremor, (6) Gross Movements, and (7) Brain Potentials. All the measures except the brain potentials were recorded simultaneously with photographic methods. The type of photopolygraph has been described by Darrow.[2] The galvanic skin resistance was recorded through the use of a Behavior Research Resistance Box.[3] The brain waves were recorded through the use of crystaline recording methods.[4] The records of physiological changes were interpreted by methods similar to those used by Darrow and Heath, Wenger, Larsen, and Jasper.[5]

RESULTS

A total of fifty-two physiological measures were available for evaluation. These consisted of physiological changes during the entire experiment. Critical ratios were computed for each of these to discover which were diagnostic in the differentiation of emotionality. Seventeen measures had critical ratios above 2.00 and ten of these had critical ratios above 2.70. These measures are given in Table 1. A general survey of the differences between the experimental (emotionally unstable) and the control (emotionally stable) groups indicated that the physiological changes occurring during the various experimental conditions, and especially during frustration, were exaggerated in the experimental group.

[2] *C. W. Darrow, The behavior research photopolygraph, J. General Psychol., 1932, 7, 215-219.*

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TABLE 1

PHYSIOLOGICAL MEASURES AND THEIR CRITICAL RATIOS

Measure	Average		Sigma		CR
	Cont.*	Exper.**	Cont.*	Exper.**	
I. Rest					
1. Sigma of Respiration	1.53	2.53	.55	1.42	2.86
2. Hand tremor	1.14	3.14	.98	2.40	3.34
3. Initial Resistance (Ohms)	7,150	12,000	2,460	7,000	3.06
4. Leg Movement	.12	.43	.19	.53	2.46
5. Number of Respirations	9.30	10.80	2.25	2.46	2.00
II. Attention					
6. Equation of Galvanic response	45.5	8.9	20.	16.	6.00
7. % Change Resistance	-15.0	-25.2	10.9	13.4	2.60
8. % Change of Pulse rate	.95	3.70	6.0	3.2	2.30
III. Learning					
9. % Change in Galv. resistance	6.7	-17.2	17.	24.2	3.52
IV. Frustration					
10. % Change in Galv. resistance	-3.7	-22.2	13.6	15.6	3.70
11. % Change in pulse rate	3.5	7.4	4.7	4.8	2.44
V. Rest					
12. Hand tremor	.93	2.86	1.18	2.37	5.45
13. % Change in Pulse rate	-3.8	0	3.26	4.23	3.10
VI. Stimulation					
14. Equation of Galv. response	46.	18.	10.	11.	8.10
15. Blood Pressure Change	3.6	5.0	1.38	2.02	3.90
16. % Change Galv. Resistance	-24.1	-35.8	13.8	18.5	2.16
17. EEG (% of alpha dominance)	85.2	62.1	11.2	15.4	2.90

*Control Group **Experimental Group

This greater response pattern may be due to a greater sensitivity to stimulation or may be accounted for as an inability to control these autonomic activities once they are initiated by a stimulating situation.

Group Differences: (1). Galvanic Skin Resistance. The initial skin resistance of the control group was 7,150 ohms and that of the experimental group was 12,000 ohms. The critical ratio between these measures was 3.06. This difference may be due to the general reactivity of the two groups. The members of the control group were physiologically in a condition which made reactivity possible with the least disturbance of autonomic functions, whereas the members of the experimental group were in a sense "frozen" and when stimulated reacted more violently. This is shown by the fact that the resistance of the control group varied only slightly during the different experimental situations while that of the experimental group varied greatly.

During the first rest period there was no significant difference between the two groups in the per cent rise in galvanic skin resistance. There was a significant difference when the subject's attention was called to the learning process. The members of the experimental group were more disturbed by the process of attention as indicated by a drop of 25.3 per cent in resistance than were those of the control group who showed a 15.0 per cent drop in resistance. The critical ratio of this measure was 2.60. The control group made an adjustment to the learning process as indicated by a 6.7 per cent rise in the resistance level. The experimental group, however, showed a drop of 17.2 per cent which indicated that an adjustment was not made and that tension continued throughout the period. The critical ratio of the measure was 3.52.

During the frustration period the control group showed a drop in resistance level of 3.7 per cent which may indicate feelings of concern about the failure. The experimental group during the same period of time showed a drop in resistance of 22.2 per cent. The critical ratio of this measure was 3.70. These changes indicate that the same physiological processes were at work in the two groups but that the members of the experimental group were more disturbed than were those of the control group.

Another measure of the galvanic skin resistance which proved to be significant in differentiating between the two groups was that of the equation of the galvanic skin response. During the period of attention the equation of the galvanic response for the control group was 45.5, whereas that of the experimental group was 8.9. The critical ratio was 6.00. The response during sensory stimulation for the control group had an equation of 46.0 and for the experimental group 18.1. The critical ratio was 8.10. This measure indicated that the members of the control group were better able to reorient themselves to the total situation than were the members of the experimental group.

(2). Heart Rate. The initial heart rate of the two groups was the same but during the experimental procedures there was a slightly greater speeding of the rate in the experimental than in the control group. This difference was not significant for the first stimulating conditions. The heart rate in the last rest period showed a reliable difference between the groups. The control group returned to a slower rate than was maintained before frustration, whereas the experimental group returned only to the former level. The critical ratio of this measure was 3.10. This

indicated, as did the equations of galvanic responses, a faster and more complete return to the prestimulus level of physiological activity for the members of the control group.

(3). Blood Pressure. The blood pressure changes were not significantly different in the two groups except during sensory stimulation. The blood pressure of the experimental group rose sharply during sensory stimulation, and was indicated by an average displacement of 5.0 mm. on the recording paper. The change for the control group was only 3.6 mm. The critical ratio was 3.90. This is another example of the exaggerated reaction of the experimental group.

(4). Tremor Movements. The measures of hand movements indicated that the experimental group was more tense than the control group. The tremor movements before and after stimulation of the control group were 1.14 and .93 per half minute respectively. In the experimental group the tremor movements in the same periods were 3.14 and 2.85 movements per half minute. The critical ratios for these measures were 3.34 and 5.45 respectively. The gross movements were not significantly different in the two groups.

(5). Respiration. The irregularity of the respiratory movements as measured by the standard deviation of their individual amplitudes showed a marked difference in the two groups. The sigma of the amplitudes of the control group was 1.53 mm., whereas that of the experimental group was 2.54 mm. The critical ratio of this measure was 2.86. The control group had an average of 9.3 respiratory movements per half minute and the experimental group had an average of 10.8 movements per half minute. The critical ratio of this measure was 2.00. A study of the complete respiratory cycle indicated that the more regular and slower respiratory movements were manifested by the normal group of children.

(6). Electroencephalogram. The alpha rhythm was dominant 85 per cent of the total time in the control group and 62.1 per cent in the experimental group. The critical ratio of this measure was 2.90. It has been pointed out in other studies of brain potentials that the alpha rhythm is suppressed during sensory stimulation. Since stimulation of the exteroceptors will suppress these waves it is probable that stimulation from the interoceptors (and of the autonomic nervous system) may also have the same effect. If this is the case there would be a suppression of the rhythm in individuals who are more or less continually emotionally disturbed. In this study it was found that there was a greater suppression of the alpha rhythm in the more disturbed individuals.

Individual Differences: The seventeen physiological measures which were shown to be significant in differentiating the control and experimental groups were then applied to the members of the experimental group. The subjects in the experimental group were observed over a long period, and extensive information was available. The following data other than the physiological measures were available; mental age, intelligence quotient, social maturity age, the scores on the Vineland scale of emotional stability, and ratings of emotional stability by trained observers.

The following physiological measures correlated most highly with emotionality: (1) per cent change of galvanic skin resistance during frustration, .79. (2) Dominance of the alpha rhythm in the electroencephalogram, .73. (3) Sigma of respiratory amplitudes, .60. (4) Initial

galvanic skin resistance, .56. (5) Pulse rate change at attention, .56. (6) Hand tremor before frustration, .56.

A better picture of an individual's physiological instability was obtained when all of the measures were considered. It was arbitrarily assumed that a subject was unstable when more than half of his measures were outside of one sigma of the mean of the control group. This assumption fitted very well the cases in this study. Six of the eighteen subjects in the experimental group showed patterns of physiological activity which fitted into the stable group. Four of these were well adjusted in the socially accepted manner. Two subjects of the experimental group were schizophrenic, and responded physiologically like the normal subjects. This indicated that well adjusted and psychotic individuals present the same stable physiological pattern. The remaining twelve subjects showed varying degrees of physiological instability which correlated highly (.79) with their emotional adjustment as judged by trained observers.

Further results of individual differences as well as the factor analysis will appear in another paper which is in the process of publication.

SUMMARY

A total of fifty-two physiological measures were taken during several experimental situations in eighteen emotionally unstable and twenty very stable children. The physiological measures were of respiration, galvanic skin resistance, pulse rate, muscle tension, and brain waves. The various experimental situations consisted of rest, attention, learning, frustration, recall, and sensory stimulation.

Ten measures had critical ratios above 2.70 which ruled out chance factors in their differentiation of the two groups. These measures were correlated with the reaction patterns of the members in the experimental group. The variance of the scores of this group from the mean scores of the control group gave a good indication of the individual's instability.

The results warrant the following tentative conclusions:

1. The following ten measures were most significant in the differentiation between the stable and unstable groups: (1) Initial galvanic skin resistance, (2) Per cent change of level of resistance during learning, (3) Per cent change of resistance during frustration, (4) Equation of galvanic responses at attention and sensory stimulation, (5) Hand tremor before frustration, (6) Hand tremor after frustration, (7) Blood pressure change at sensory stimulation, (8) Dominance of the alpha rhythm in electroencephalogram, (9) Standard deviation of the amplitudes of respiratory movements, and (10) Change in heart rate after frustration.

2. The experimental group showed an exaggerated physiological reaction pattern as well as a slower return to the prestimulus level of physiological activity.

3. The variance of the measures of the unadjusted individuals from the mean measures of the adjusted group gave a good indication of the degree of emotional disturbance. These measures correlated .79 with the ratings of these children regarding their emotional reactivity.

4. The psychotic and well adjusted individuals presented the most

stable physiological patterns; whereas the pre-psychotic and neurotic individuals presented the most unstable patterns.

5. Unstable individuals reacted more violently to a frustration situation than did the stable individuals as measured by their physiological reactions. The unstable individuals also showed more variable patterns of physiological activity during the control periods than did the stable individuals.

6. The physiological tensions resulting from frustration are motivational but not directive in action. They are less variable from individual to individual and are thus probably a better measure of the reaction to frustration than are the more variable overt reactions.

DEVELOPMENT OF ROTARY-VESTIBULAR REACTIONS OF THE HUMAN INFANT

MYRTLE B. McGRAW[1]

During the past few years a series of investigations concerning selected activities common to the growing infant have been undertaken with the purpose of determining those changes in overt behavior which reflect reorganization of neural mechanisms. Among the activities studied was the changing postural and ocular behavior of the infant to bodily rotation. Attempts to control the circumstances so that particular vestibular canals would be stimulated by the rotation were futile, since the conditions adaptable to a newborn infant were met with violent resistance by an older baby. However, if an infant is held under the arms by the experimenter who spins around so as to move the baby's body through an orbit definite vestibular and ocular adjustments occur. Successive changes in these vestibular adjustments are of developmental significance.

This method of holding the infant in a vertical position, facing the experimenter who turned around in situ, was utilized in studying the reactions of 67 children ranging in age from birth to approximately two years. The children were examined at repeated intervals, so that the total number of observations was 687. The number of rotations during each examination was counted, and the time consumed in spinning was measured by stop watch. The average speed of turning was 0.778 rotations per second, with a standard deviation of $\pm$0.113. Obviously the rate of rotation was fairly constant regardless of the age of the child. Bodily and ocular adjustment as detected by direct observation were recorded in dictated protocols. Major recordings concerned the adjustment of the infant during rotation rather than recovery reactions.

Examination of the records revealed that characteristic changes may be conveniently classified into three phases, in accordance with the following criteria:

A. Lateral Deviation Phase:

With the newborn infant it is observed that during rotation both the head and eyes tend to deviate in the direction of rotation and remain in the deviated position. That is, if the child's body is moving toward his left, he turns both the face and eyes leftward. When the rotation ceases the head and eyes turn toward the opposite direction. The reaction is slow, and often there occurs a pause at the midline before the compensatory response is completed. Whenever this type of reaction was elicited the infant was accredited a plus rating in Phase A.

B. Gross Oscillatory Phase:

Within a few months it will be observed that, during the rotation, the face of the infant may remain forward but the eyes tend to make gross, slow horizontal excursions. Similar gross oscillations continue usually for a few seconds after rotation. At the onset of this phase the face may, during rotation, turn against the direction of rotation and the

[1] *From the Normal Child Development Study of the Department of Pediatrics, Columbia University, and the Babies Hospital.*

excursions of the eyes may be only to the midline. With increasing development these oscillations are more pronounced and are of greater amplitude. Both types of reactions were accredited a plus rating in Phase B.

C. Fine Oscillatory Phase:

With further development the child tends during the turning to hold the face forward and oscillations of the eyes are fine and rapid. At the onset of this phase the child may manifest an axial rotation of the head on the shoulders, and toward the end of it he may show no pronounced overt response during rotation, but will stagger, fall to his feet, or otherwise show equilibratory disturbance when he is placed upon his feet. Plus ratings were accorded to Phase C if the eye movements during rotation were fine and rapid, or if they were undetectable by direct observation. No effort was made to distinguish between the slow and rapid com-

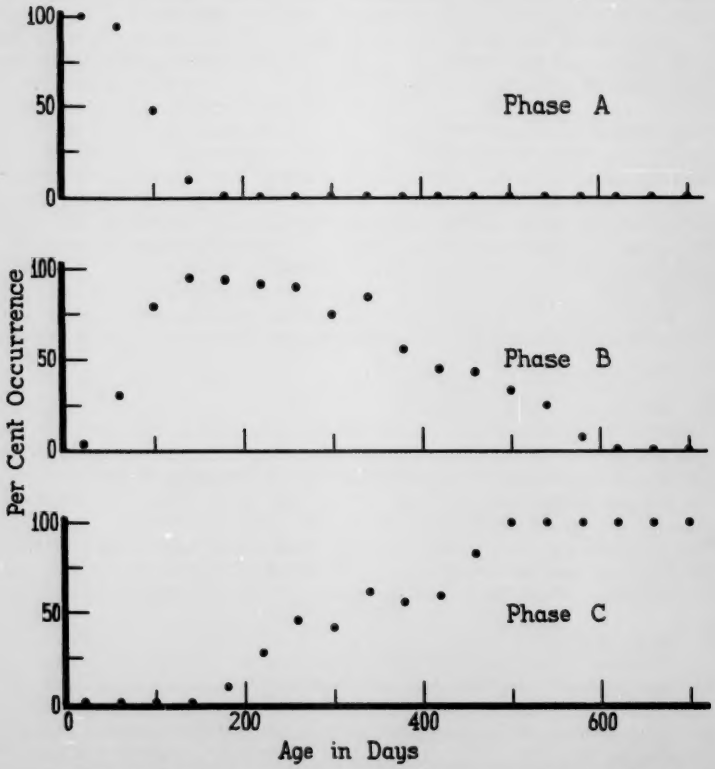

Fig. 1. Curves showing during each age interval the percentage occurrence of developmental phases in the infant's adjustment to rotation.

ponents, and the ratings were based upon the adjustments during rotation more than on the post-rotary reactions.

After the reactions were rated according to the above criteria it was possible to determine the percentage of occurrence of each phase during any age interval. The trend of development of each phase, calculated in intervals of forty days, is shown in the curves of Figure 1. It was found that the greatest percentage of children began to show a shift from Phase A to Phase B about the end of the fourth month. It is interesting to note that this is about the time that most children begin to show distinct evidence of object-vision (1). The onset of Phase C occurs around the seventh month, which corresponds to the time when equilibratory control is manifested in other activities such as the maintenance of a sitting posture (2). This phase, however, does not become stabilized until about the end of the second year, and by that time the child manifests almost optimum control of the function of equilibration (3).

DISCUSSION

The function of the vestibular apparatus is so complex and so interwoven with other receptors (4) that developmental signs are difficult to appraise. It seems clear, however, that it is a mechanism concerned with the attitude of the body both at rest and in movement. The changing adjustments of the infant to rotation indicate reorganization of the neural system involved. There is considerable doubt that the cerebral cortex exercises much influence upon these labyrinthine reflexes. If that is the case, then the development observed in the changing reactions of the growing infant to rotation must reflect maturation essentially in the subcortical nuclei. It is hoped the gross changes in overt behavior as here delineated may serve to stimulate more thorough investigation of the developmental aspects of a complex phenomenon.

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A STUDY OF THE INTELLIGENCE OF ITALIAN AND POLISH SCHOOL CHILDREN FROM DETERIORATED AND NON-DETERIORATED AREAS OF CHICAGO AS MEASURED BY THE CHICAGO NON-VERBAL EXAMINATION[1]

ANDREW W. BROWN AND CAROL B. COTTON[2]

INTRODUCTION

Individual differences due to nationality have been the subject of many investigations and much controversy during the last twenty-five years. In discussions of test results the three environmental factors which, in addition to the constant national differences, have received considerable attention are, 1) the foreign language handicap, 2) the socio-economic-cultural level of the child and his parents, 3) differences in education and temperament. Wide disparity in any or all of these influencing agencies might so distort test results as to render them valueless.

Thus it is evident that if it were possible to hold two or more of these factors constant, the varied effect upon test scores of those remaining might be studied. Since the foreign language handicap has been the factor upon which the claim of invalidity is most frequently based, a non-verbal test which retains the better features of the verbal type should, theoretically, operate to hold this variable constant. Differences in education may be confined fairly rigidly by limiting investigation to the schools of a single system. While it is recognized that public schools within any one system are not indentical, differences should tend to disappear when averages or general tendencies are being considered.

The purpose of this investigation was, then, twofold: first, to determine the degree to which, with the language factor minimized, Chicago school children of Polish and Italian parentage approximate the level of the general population of school children in intelligence; and second, to investigate the influence of such factors as age, sex, socio-economic community level, and length of parents' residence in America, upon intelligence test scores. There was also the possibility that the study might throw some light upon the question of the selectiveness of areas within the city, as suggested by Goodenough (2).

Since the publication of the results of the tests given the United States Army during the World War, which showed the Italians and Poles ranking lowest of seventeen national and social groups, many studies have been made of Italian children and several of Polish children in this country. Almost without exception they have been found among the lowest of all rank orders, whether the tests upon which these findings were based were verbal or non-verbal.

[1] *Studies from the Institute for Juvenile Research, Chicago, Paul L. Schroeder, M.D., Director. Series C, No. 315.*
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[2] *The authors wish to acknowledge the splendid co-operation they received from the teachers and principals of the Chicago Public Schools. Special thanks are due Dr. Grace F. Munson, Director of the Bureau of Child Study. The authors also acknowledge the technical assistance given them by Mr. Seymour Stein. Thanks are also due to W.P.A. for assistance in this work.*

Most objections to the non-verbal as opposed to the verbal test in group intelligence testing are based on the assumption that as performance tests they are measures of a different sort of ability or skill than that which the verbal tests measure. Perceptual-motor skill is often pointed out as a requisite for high scores in most batteries of non-verbal tests, and it is further emphasized that often such tests have no gradations in difficulty, hence, are not true measuring devices. This particular criticism cannot be made of the Chicago Non-Verbal Tests, the instrument used in this investigation. It is a non-language group test battery designed for either verbal or pantomime administration.

The second purpose of this study, the comparative investigation of the socio-economic factor, necessitated a selection of dwelling areas which should differentiate as sharply as possible good from poor environmental backgrounds. Two areas were selected in which the rates of delinquency were high and the economic status low. One was heavily Italian in population and the other heavily Polish. These were two of the most deteriorated areas in the city according to the criteria used by Shaw (7) in his study of delinquency in the city of Chicago. Another area was selected which, according to Shaw's studies, had the highest economic status and lowest delinquency rates, and which at the same time provided a high concentration of both Polish and Italian children in the population. Throughout this article the poor areas in each case are known as "Area I" and the better area as "Area II."

METHOD OF STUDY

The Chicago Non-Verbal test was given with verbal directions to every child in the fourth grade and above in six schools. The subjects' age range was from eight to sixteen. On each test blank the children were directed to give the place of birth of father and place of birth of grandfather. No data concerning maternal ancestry were secured.

Testing was done by two examiners well trained in the technique of administering the test and extended over a period of about three months during the Fall of 1936. The test papers of all the children of Italian and Polish extraction from 10 to 14 years of age were then selected for study. In the Italian Area I, there were 421 children (210 boys and 211 girls) who fell within these age limits, and in Italian Area II, there were 259 children (142 boys and 117 girls). In the Polish Area I, there were 433 children (205 boys and 228 girls) who were within this age range, and in Polish Area II, there were 149 children (63 boys and 86 girls).

RESULTS

1. Italian Areas. Table 1 gives a comprehensive tabulation of the results obtained for the Italian children in terms of mean raw scores transmuted into standard scores, computed, for purposes of comparison, on the basis of the age norms of the standardizing group, the number in each age group, and the critical ratio of the difference of the means. Figure 1 shows the result of placing these mean standard scores in graph form. Possibly the most striking factor in these results is the general

drop in mean standard score for all groups, as chronological age increases.

In all four groups, the younger children come closer to approximating the zero standard score expected for an unselected group, the negative scores tending to increase steadily with age, with five minor exceptions. The general drop at age 14 might be accounted for by the fact that the brighter children at 14 have been promoted to high school, leaving only the duller ones in elementary schools, or the brighter and more energetic children may have left school to go to work. But this does not account for the steadiness of the decline over the five-year period, a decline with few exceptions. This suggests a possibility that the Italian children in this area tend to reach the limits of their mental capacity early, or it may be that the drop with age in test scores may be due to lack of stimulative influence in the community.

TABLE 1

COMPARISON OF ITALIAN CHILDREN AT DIFFERENT AGE LEVELS IN DETERIORATED AND NON-DETERIORATED AREAS

Age	Number	Mean z score	Difference M_1-M_2*	D/PE_D
		BOYS		
		Area I. (Deteriorated)		
10	22	-0.206	- 8.8	5.1
11	36	-0.521	-14.6	7.2
12	57	-0.375	-11.4	6.1
13	45	-0.616	-13.7	6.4
14	50	-0.694	-13.4	8.5
		Area II. (Non-Deteriorated)		
10	27	-0.493	-14.2	6.7
11	33	-0.520	- 4.5	3.1
12	30	-0.487	-13.5	8.3
13	25	-0.682	-15.1	5.4
14	27	-1.061	-20.0	6.7
		GIRLS		
		Area I. (Deteriorated)		
10	37	-0.104	- 6.9	3.8
11	32	-0.812	-20.6	9.3
12	39	-0.710	-17.7	8.2
13	59	-0.826	-18.1	13.1
14	44	-1.104	-20.7	11.2
		Area II. (Non-Deteriorated)		
10	28	-0.633	-16.8	7.3
11	30	-1.048	-15.7	5.9
12	29	-1.165	-26.2	13.7
13	20	-0.739	-16.3	7.3
14	10	-0.700	-13.5	3.2

* M_1 - Mean Raw Score of Standardizing Group
M_2 - Mean Raw Score of Experimental Group

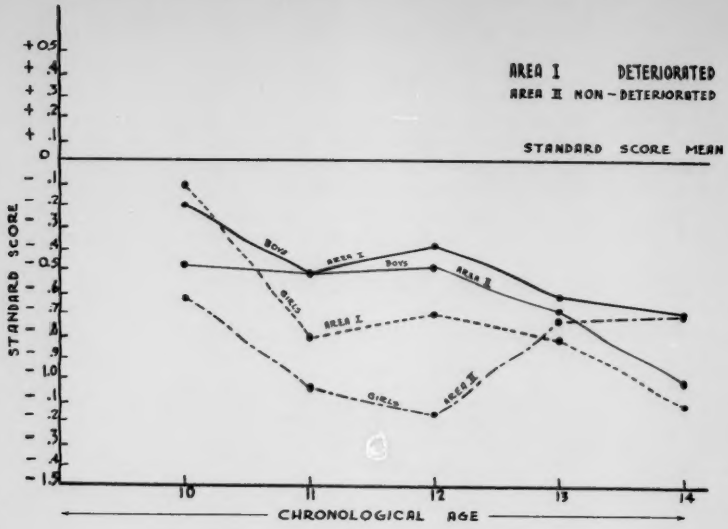

Fig. 1. Comparison of Italian children at different age levels in deteriorated and non-deteriorated areas.

Table 2 presents a comparison of Italians in Areas I and II. Boys in Area I differ but little from boys in Area II, the mean standard scores from the deteriorated area being slightly higher than those from the better area. The same is true of the girls in these areas, the mean standard score of the Area I girls being reliably higher than that of Area II. When all children in Area I are compared with all those in Area II, the difference to the advantage of Area I is still significant. So far as the results of this investigation show, there is no advantage in Area II over Area I for Italian children. The representatives of Area II were, however, fewer for both sexes.

Table 3 shows the result of comparing the scores of the boys with those of the girls. While in Area I the difference reliability is open to question, in Area II there is a statistically significant difference, the boys having uniformly higher scores. This difference is even greater when the two areas are thrown together. This finding is in direct contrast to that usually found when sexes are compared. On verbal group tests, girls are generally found to have the higher scores, although the difference is not large. Such findings have given rise to the theory that girls do better work on verbal material than boys. Pinter (4-6) has found, on the contrary, a slight difference in favor of boys. The results may be an artifact of the test material, they may be an indication of the relative abilities of the sexes on non-verbal material in general, or they may indicate a difference in traditional training.

TABLE 2

COMPARISON OF ITALIAN CHILDREN IN DETERIORATED AND NON-DETERIORATED AREAS

(Area I Deteriorated, Area II Non-Deteriorated)

	No.	Mean Z Score	Difference $M_1 - M_2$*	D/PE_D
Boys Area I	210	-0.510	2.95	1.87
Boys Area II	142	-0.639		
Girls Area I	211	-0.734	7.54	5.81
Girls Area II	117	-1.066		
All Children Area I	421	-0.622	4.77	4.91
All Children Area II	259	-0.831		

* M_1 - Raw Score Mean for Area I
M_2 - Raw Score Mean for Area II

TABLE 3

COMPARISONS OF ITALIAN BOYS WITH ITALIAN GIRLS

(Area I Deteriorated, Area II Non-Deteriorated)

	No.	Mean Z Score	Difference $M_1 - M_2$*	D/PE_D
Boys Area I	210	-0.510	5.15	3.63
Girls, Area I	211	-0.734		
Boys Area II	142	-0.639	9.74	6.64
Girls Area II	117	-1.066		
All Boys	352	-0.562	6.65	7.08
All Girls	328	-0.803		

* M_1 - Raw Score Mean for Boys
M_2 - Raw Score Mean for Girls

2. Polish Areas. Table 4 is a tabulation of the results of the study for Polish children.

It will be noted that the same tendency just mentioned as found among Italian children is also present here - an increasing negative deviation in mean standard score with increase in age. Figure 2 depicts the data graphically. While the results for Area II are open to question because of the small age groups, the number in Area I is sufficiently large to justify the conclusion that, for these children, there is a more or less steady decrease in mean S.S. with increase in age. The decrease for boys in Area I is sharply accelerated at age 12, increasing thereafter to a point of doubtful significance at age 14. This sudden decrease occurred in both the first and second generation boys, with

TABLE 4

COMPARISON OF POLISH CHILDREN AT DIFFERENT AGE LEVELS IN DETERIORATED AND NON-DETERIORATED AREAS

Age	Number	Mean z score	Difference $M_1 - M_2$*	D/PE_D
		BOYS		
		Area I. (Deteriorated)		
10	21	-0.186	- 8.5	3.3
11	39	-0.352	-10.8	5.1
12	52	-0.789	-19.2	10.1
13	55	-0.616	-13.7	7.5
14	38	-0.323	- 6.7	3.8
		Area II. (Non-Deteriorated)		
10	5	-0.150	- 7.8	1.3
11	7	+0.207	+ 1.4	0.4
12	15	-0.246	- 9.0	2.5
13	17	-0.093	- 5.6	1.3
14	19	-0.734	-14.1	3.8
		GIRLS		
		Area I. (Deteriorated)		
10	34	-0.246	- 9.6	5.0
11	41	-0.773	-19.8	8.2
12	50	-0.503	-13.8	8.5
13	56	-0.806	-17.7	10.7
14	47	-1.049	-10.8	10.8
		Area II. (Non-Deteriorated)		
10	12	-0.187	- 8.5	1.5
11	13	-0.299	- 9.4	3.5
12	22	-0.633	-13.8	8.5
13	26	-0.627	-14.0	7.2
14	13	-0.466	- 9.3	2.7

* M_1 - Mean Raw Score of Standardizing Group
M_2 - Mean Raw Score of Experimental Group

subsequent increase at 13 in both groups. The girls in Area I exhibit a decrease, slightly interrupted at age 12, but accelerated, as might be expected for reasons already given, at age 14.

Area II is represented by too few children for the results by age groups to be reliable, but as Figure 2 indicates, the better area has the advantage over the poorer area, a suggestion which is supported when all age groups are thrown together as in Table 5. If some of the brighter children leave school at 14 to go to work, it may be that under the better economic conditions of Area II these children find it possible to remain in school. However, this is little more than a suggestion, since conclusions based on 13 persons cannot be regarded as valid.

Comparison of all Polish boys in Areas I and II (Table 5) shows no difference in favor of either area. This is in contrast to the findings for Italians, where there was a slight difference in favor of the poorer

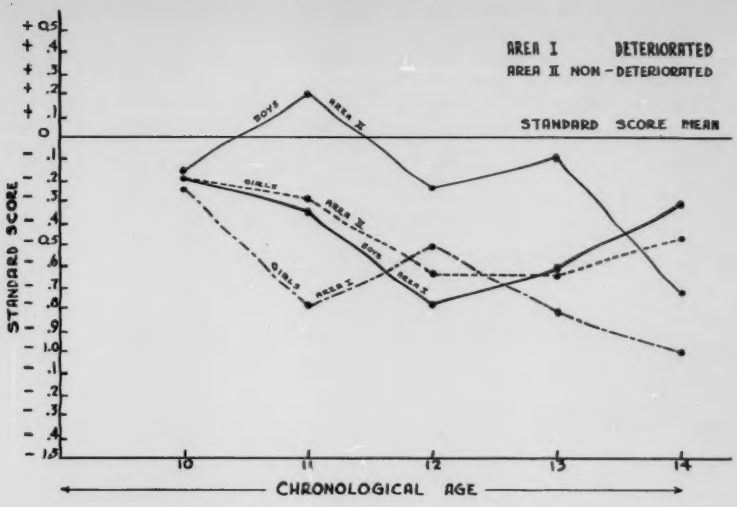

Fig. 2. Comparison of Polish children at different age levels in deteriorated and non-deteriorated areas.

TABLE 5

COMPARISON OF POLISH CHILDREN IN AREAS I AND II

(Area I Deteriorated, Area II Non-Deteriorated)

	No.	Mean Z Score	Difference $M_1 - M_2$*	D/PE_D
Boys Area I	205	-0.496	-0.42	0.20
Boys Area II	63	-0.293		
Girls Area I	228	-0.701	-5.39	3.09
Girls Area II	86	-0.493		
All Children Area I	433	-0.604	-2.68	2.17
All Children Area II	149	-0.407		

* M_1 - Mean Raw Score, Area I
M_2 - Mean Raw Score, Area II

area. Results for Polish girls point toward a possible favorable influence of the better area on test scores.

The results of the investigation point to the slightly beneficial effects of a better community upon the mean scores of Polish children, although whether the factor Goodenough (2) mentions is operative is open

to question. In this respect, so far as this study is concerned, the Poles and Italians show reliable differences.

Table 6 - a sex comparison of the Polish boys and girls within areas, demonstrates again a tendency for the boys to surpass the girls. This difference, while fairly large in Area I, is by no means as striking as in the case of the Italians. There is no demonstrable difference in Area II.

TABLE 6

COMPARISON OF POLISH BOYS WITH POLISH GIRLS

(Area I Deteriorated, Area II Non-Deteriorated)

	No.	Mean Z Score	Difference $M_1 - M_2$*	D/PE_D
Boys Area I	205	-0.496	+5.03	3.14
Girls Area I	228	-0.701		
Boys Area II	63	-0.293	-0.78	0.34
Girls Area II	86	-0.493		
All Boys	268	-0.447	+3.45	3.16
All Girls	314	-0.644		

* M_1 - Mean Raw Score Boys
M_2 - Mean Raw Score Girls

The second generation children in Area II were too few to permit valid comparison with Area I second generation children. Interesting results were observed, however, in comparing the second generation children of Area I with the first generation children of Area II. The results of Giardini (1) and Mead (3) indicate that the degree of the Americanization of parents has some effect upon mental test scores. Our study shows that the influence of the better neighborhood, for the group included in this study, is about equal to the influence of American-born parents. Whereas a fairly large difference is found between first and second generation boys in Area I, there is no difference between these second generation boys and the first generation boys of Area II. The same tendency is found among the girls, although in Area I the differences are not so pronounced. These results, while by no means conclusive, are suggestive.

Table 7 presents the results of a comparison of the two national groups in the two areas. There is no significant difference between either boys or girls in the poorer areas. In the better areas, on the other hand, scores for the Polish girls are significantly higher than for the Italian girls. The mean score for all Polish boys, i.e., the Polish boys from both areas, is not higher than the mean score for all Italian boys, but the Polish girls from both areas make significantly higher scores than do the Italian girls. The difference is found to be consistent, though slight, when age levels are compared. The scores of Polish girls and of Polish boys differ appreciably, but not significantly; among the Italians the sex differences are statistically significant.

In general, the groups under investigation are slightly under the

TABLE 7

COMPARISON OF THE TWO NATIONAL GROUPS IN THE TWO AREAS

	No.	Mean Z Score	Difference $M_1 - M_2$*	D/PE_D
Polish Boys, Area I	205	-0.496	1.47	0.96
Italian Boys, Area I	210	-0.510		
Polish Girls, Area I	228	-0.701	0.27	0.24
Italian Girls, Area I	212	-0.734		
Polish Boys, Area II	63	-0.293	2.19	1.22
Italian Boys, Area II	142	-0.639		
Polish Girls, Area II	86	-0.493	13.19	10.90
Italian Girls, Area II	117	-1.066		
All Polish Boys	268	-0.447	1.24	1.16
All Italian Boys	352	-0.562		
All Polish Girls	314	-0.644	4.43	4.62
All Italian Girls	329	-0.803		
All Polish Boys	268	-0.447	3.45	3.17
All Polish Girls	314	-0.644		
All Italian Boys	352	-0.562	6.65	7.08
All Italian Girls	329	-0.803		

* M_1 - Mean Raw Score for First of Pair
M_2 - Mean Raw Score for Second of Pair

norm, and means show a steady decrease, or a steadily widening distance away from the norm, with increase in age. The deviations from the norm, however, even at year 14, are never as great as those indicated by verbal test results.

One possibility is that the duller ten- or eleven-year old children were not included in the study, since, if they had been two or more years retarded, they would not be in the fourth grade. The relatively greater twelve- and thirteen-year old population lends some strength to this possibility. In that case, the data for ten- and eleven-year-old children might be drawn from selected cases and thus a higher mean S.S. might be expected at these levels, just as a sharp drop at year fourteen might be expected if the brighter fourteen-year-olds had left elementary school for high school or work, the selection in this case operating to skew the curve to the right.

Retest in the Spring of 1940 of the children who were in Grade Four in 1936 failed to show a decrease in mean test performance, but there were too few cases represented to ensure reliable results.

SUMMARY AND CONCLUSIONS

1. Italian and Polish children in deteriorated and non-deteriorated areas in Chicago were tested with the Chicago Non-Verbal mental examination with the result that both national groups, in both areas, ranked slightly below the norms in the Non-Verbal test.

2. There was a regular decrease in mean test performance from age 10 to age 14 for both sexes and both national groups.

3. For Italian boys there was no statistically significant difference between areas. For Italian girls significant differences were found in favor of the deteriorated area. Polish children in the non-deteriorated area were too few for positive comparative statements; however, children from the non-deteriorated area tended to make uniformly better scores. Scores of the second generation Polish children in the poorer area were practically the same as those of first generation Polish children from the better area.

4. Italian boys demonstrated ability in this test significantly superior to that of Italian girls. Polish boys had higher scores than Polish girls, but the differences were relatively slight.

5. These findings emphasize the influence of the socio-economic, cultural, and educational factors upon test scores even when the language factor is minimized.

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NEURAL MATURATION AS EXEMPLIFIED IN THE CHANGING REACTIONS OF THE INFANT TO PIN PRICK

MYRTLE B. McGRAW[1]

In a series of studies (6, 7, 8, 9) of the early motor development of the infant it has been shown that alterations in overt behavior can be interpreted rationally as evidence of organization of the central nervous system. An analysis of sensory development in the infant, segregated from motor functioning, is precluded since a baby cannot report his sensory perceptions. However, changes in response to peripheral stimulation can be used to appraise maturational processes, or reorganization of sensori-motor mechanisms.

In order to determine salient features of change in overt behavior a group of 75 infants were stimulated by pin prick (blunt sterile safety-pin) at repeated intervals from birth to four years and their responses recorded either on motion picture film or by written protocols. A total of 2,008 observations were made, many of which consisted of stimulations in four different areas, these areas representing major anatomical divisions, viz., the head, trunk, upper and lower extremities. Ten pin pricks were applied to each area. Without this summation-effect the reactions might have been less intense. Efforts to control (mechanically) the intensity of the stimulus were abandoned because the diffuse movements of the child often introduced tactile or other sensations. Since this study was concerned not with sensory thresholds, but with the development of overt response to cutaneous irritation, the less cumbersome technique was adopted. Of the total number of observations 646 were recorded on motion picture film, and 1,362 consisted of descriptive reports of observable behavior.

In addition to the serial records over a period of years, daily observations were made upon four individual infants during the first 18 to 24 months of life. Two of these infants were identical twin boys; the other two were unrelated girls.

Examination of these cinema and descriptive records revealed certain significant features of the sensori-motor aspect of the behavior which reflected reorganization of the neural mechanisms involved. Similarly, salient qualities in the cognitive and conative aspects of the behavior seemed to express advancing neural maturation. The analysis of sensori-motor aspects of the behavior was based primarily upon responses to the application of the stimulus to the skin, and the cognitive and conative aspects were based upon the responses of the infant to the stimulus, (i.e., the pin), in the visual field, or to the experimental conditions in general. The sensori-motor aspects of the activity were conveniently classified into four major categories. There were also four significant phases in the cognitive and conative aspects of the behavior. However, changes in cognitive and conative aspects of the response did not necessarily parallel changes in sensori-motor functioning. These developmental phases can be better clarified by a detailed description of the criteria used in selecting the sequential stages of development.

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CRITERIA FOR ANALYZING THE BEHAVIOR

1. Sensori-Motor Aspect of the Behavior:

1A. Newborn or Diffuse Phase:

Some infants only a few hours or days old may exhibit no overt response to cutaneous irritation such as pin prick. It is impossible, therefore, to know at such times whether absence of response should be attributed to an undeveloped sensory mechanism or to a lack of connections between sensory and somatic centers, or between receptor centers and those mechanisms governing crying. Such infants usually do respond to deep pressure stimulation. In any event this period of hypesthesia is brief; by the end of the first week or ten days most infants react to cutaneous irritation. The most characteristic type of response consists of diffuse bodily movements accompanied by crying, and possibly a local reflex withdrawal of the stimulated member. The reaction is immediate and during the first month increases in intensity. The area supplied by the trigeminal nerve appears to be the most sensitive.

1B. The Inhibitive Phase:

As stated above, the intensity of the neuromuscular and the crying aspects of the behavior increases during the first month. After that there occurs a noticeable diminution of the diffuse bodily movements accompanying the crying. The reflex movements of the extremities also become less frequent. The response to the stimulus is usually delayed; the eyelids dilate and crying is the most outstanding feature of the reaction. During this period some infants show no violent reaction to the irritation. In such instances there is either a diminution in the sensory experience, or the inhibitory processes embrace the crying aspect as well as the neuromuscular accompaniment of the behavior. While the widening of the eyes and the general facial expression of the infant at this time indicate that the baby has some degree of cognition of the sensory experience, he is unable to identify the locus or source of irritation.

1C. General Localization Phase:

In the next phase it is observed that the infant begins to localize, within a wide area, the place being stimulated. If the pin is applied to an extremity, deliberate withdrawal of the stimulated member may follow. Such deliberate withdrawal movements are distinguishable from the reflex withdrawals of the newborn infant by the quality and direction of the movement. Deliberate withdrawal is directed away from the source of irritation, whereas reflex withdrawal consists primarily of flexion of the extremity. When the cheek is stimulated the baby may turn his face away or his hand may approach the neighborhood of the face, though he does not actually touch it. When the chest is stimulated he may likewise approach it with his hand or turn the whole body away. The inception of localization is primarily visual, i.e., before the somatic movements are definite the eyes of the child fix upon the locus during the stimulation. Later, both motor response and gaze indicate a general field of localization.

1D. Specific Localization Phase:

Gradually the ability to identify the point of irritation becomes more specific. The child carries his hand directly to the stimulated area. In the beginning the reaction may be a little delayed so that he touches the area after the stimulus has been withdrawn. Later he may rub the area or he will actively push the stimulus away while it is being applied. Finally he may anticipate application of the irritant and protect himself against it.

2. Cognitive and Conative Aspects of the Behavior:

2A. Passive or Newborn Phase:

At birth and for some weeks thereafter the infant manifests no overt or detectable response to the approaching pin while it is within the visual field. On the basis of overt behavior only, there is no way of knowing whether or not he possesses object vision at this time.

2B. Object Perception Phase:

Subsequently the child responds to the pin while it is held in the visual sphere, but he responds as he would to any other object. He fixes his gaze upon it, reaches for it, and if he obtains it plays with it as he would with any other toy. There is no evidence that he makes a specific association between the pin and the forthcoming stimulation.

2C. Associational Phase:

With advancing development it will be observed that perception of the pin or of the approaching arm of the adult provokes fussing, crying, or withdrawal reactions on the part of the child. Occasionally association is revealed by abortive reaching reactions; the infant starts to reach but inhibits the act before it is completed. Sometimes he merely frowns or ducks his head. At other times he attempts to prick himself, but when he does so it is because of his limited understanding, because his associations are simple and direct. Any behavioral response which indicates that the child has made some association between the pin, or the experimental conditions, and the forthcoming stimulus is indicative of this phase of development. In the latter part of the phase he may whine "no pin" (if his verbal expression has reached that level) but his expression is strikingly different from a subsequent stage when he may defiantly command, "Don't you stick me with that pin, I'll tell my mother," etc. Although he recognizes and interprets the experimental conditions he is still not the master of the situation; he still is emotionally disturbed at being a victim of an aggressive experimenter.

2D. The Integrative Phase:

In this stage the child has learned not only to associate or recognize the purpose of the experimental situation, but he is able to appraise both the severity of the situation and his own potentialities. He may aggressively defend himself, defend himself so effectively that it is difficult to apply the stimulus; he may accept it stoically and hold his arm or leg while the stimulus is being applied; or he may accept it as a game, and, if he pricks himself, it is done in a playful or sporting spirit which is unlike the direct associational or imitative pricking that occurs earlier. In any event, despite the particulars of behavior he manifests an ability to cope with the situation more or less effectively.

ANALYSIS OF THE DATA

On the basis of these criteria the 2,008 observations were given plus ratings in the phase most accurately representing the behavior as described in the original protocols. Instances which were not clearly defined were given plus ratings in two phases. For example, if the child merely looked toward the point of stimulation but showed no additional indication of localization, he received a plus rating in both Phase 1B and Phase 1C. After the observations had been rated in accordance with the above criteria it was possible to calculate the percentage occurrence of each phase within any age interval as manifested by the group. The curves in Figure 1 show the age period when each phase was manifested in the reactions of the group of 75 children. Similar curves were obtained for the individual children by calculating the percentage of plus values assigned to each phase within each age interval of 20 days. These curves are shown in Figures 2 and 3. The study was terminated on these four children before they had completely achieved the integrative phase. The distribution curves in Figure 4 show: (a) the percentage of children at each age period in whom phases of the sensori-motor aspect of the behavior were emerging, and (b) the percentage of children in whom these phases were evanescent. For example, 74 per cent of the children began to show a diminution of gross bodily movements by the end of the second month. The ogives in Figure 4 indicate the total number of children in whom each phase was manifested or had been completed at any given age; and the shaded areas indicate the percentage of children manifesting a particular phase at any given time. Similar ogives, showing the age period when the first three phases of the cognitive and conative aspects of the behavior were the most characteristic modes of response are presented in Figure 5. A comparison of these ogives with those in Figure 4 reveals that neuromuscular development is slightly in advance of the cognitive aspects of the behavior. Evanescence of the diffuse bodily movements occurs before the child manifests definite object-perception of the pin. General localization of the applied stimulus usually occurs before association of visual perception of the pin with the stimulus is indicated. Recognition of the pin and an association between it and the irritation develop concurrently with specific localization.

DISCUSSION AND INTERPRETATION

For almost a century it has been recognized that the thalamus is the subcortical center to which the sensory pathways and impulses converge. Fulton (4) has found it convenient to consider the thalamus in terms of its anatomical organization as composed of three major divisions, viz., (a) nuclei with subcortical connections, (b) cortical relay nuclei which receive fibers from the sensory systems and project them to the motor and sensory regions of the cerebral cortex, and (c) association nuclei which have connections with the diencephalic nuclei and project to the association areas of the cerebral cortex. Histological studies of the fetal and newborn brain by Tilney (11), Conel (2) and de Crinis (3) indicate that no part of the cerebral cortex is functioning appreciably at birth. Conel (1) states that the somesthetic afferent area in the newborn infant's

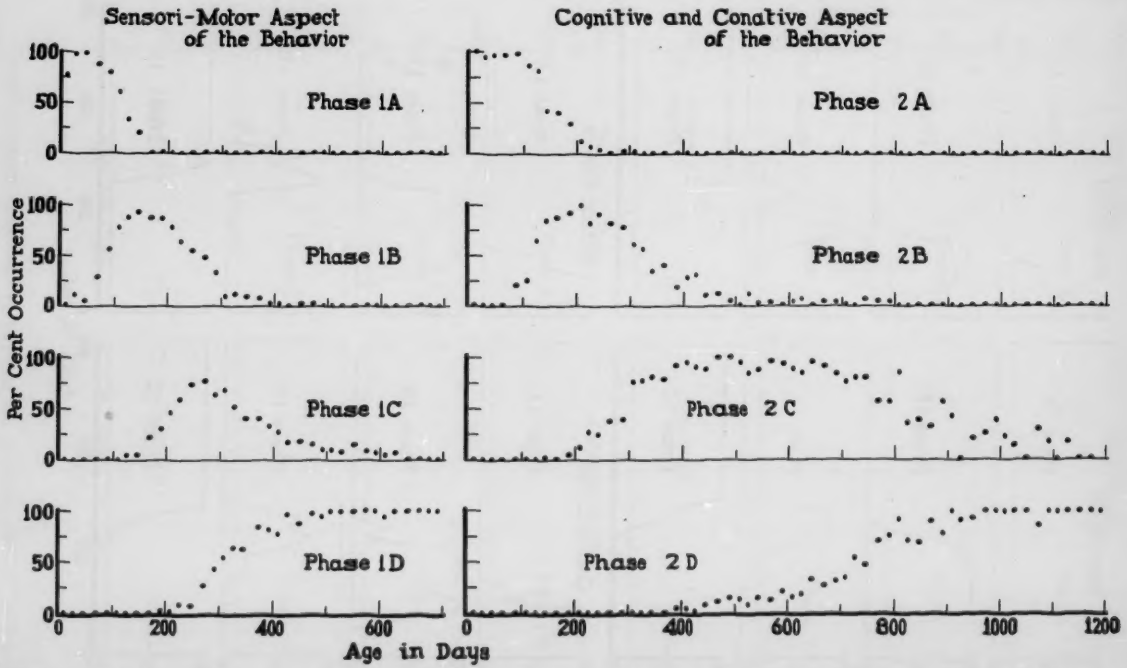

Fig. 1. The age period is shown in the above curves when each phase of the sensori-motor and the cognitive and conative aspects of the response is the characteristic mode of behavior, as represented by the group of children.

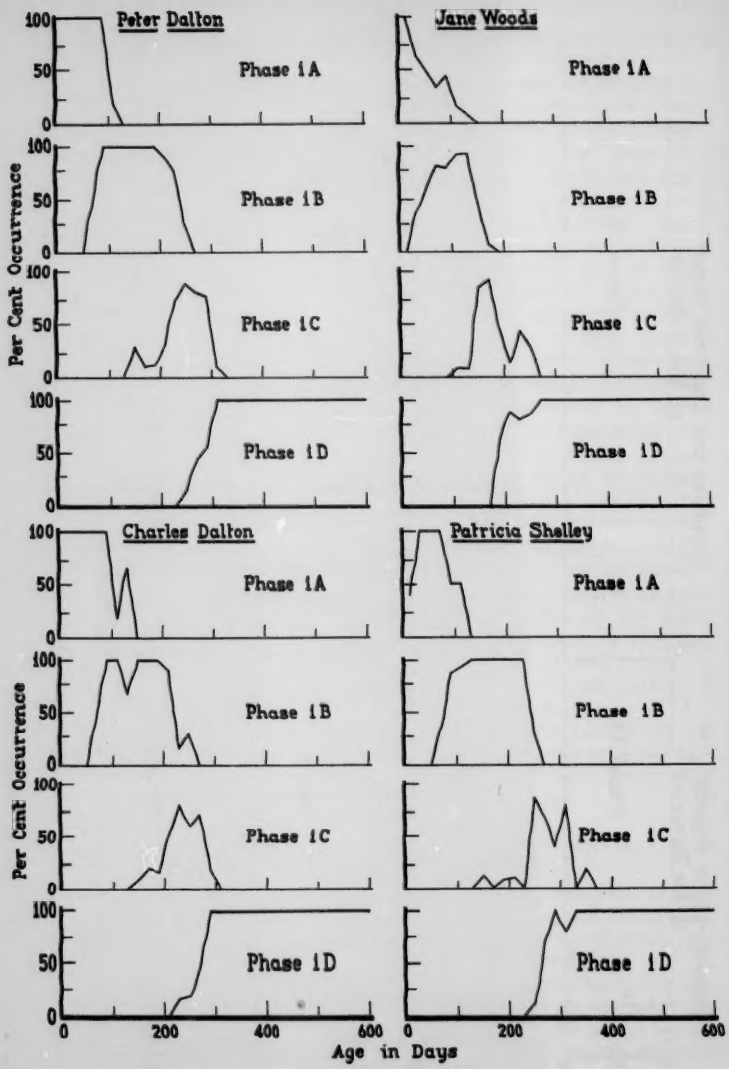

Fig. 2. Curves showing the age period when each phase of the sensori-motor aspect of the behavior was the predominant response, as manifested by identical twin boys and two unrelated girls.

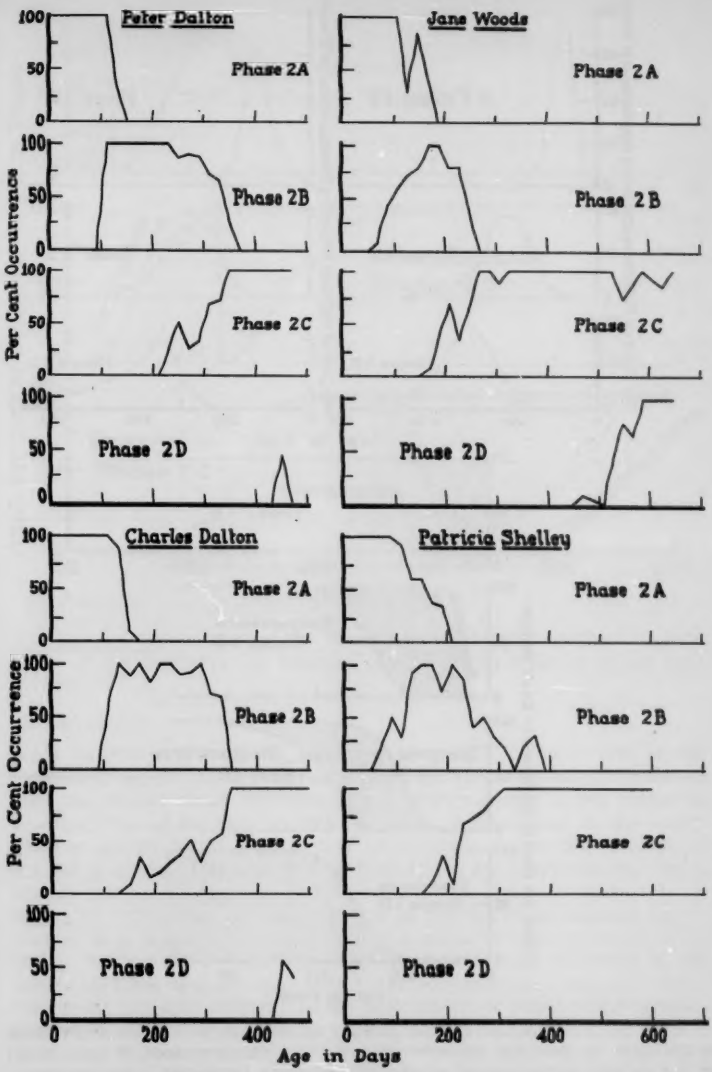

Fig. 3. Curves showing the age period when each phase of the cognitive and conative aspects of the behavior was the predominant response, as manifested by identical twin boys and two unrelated girls.

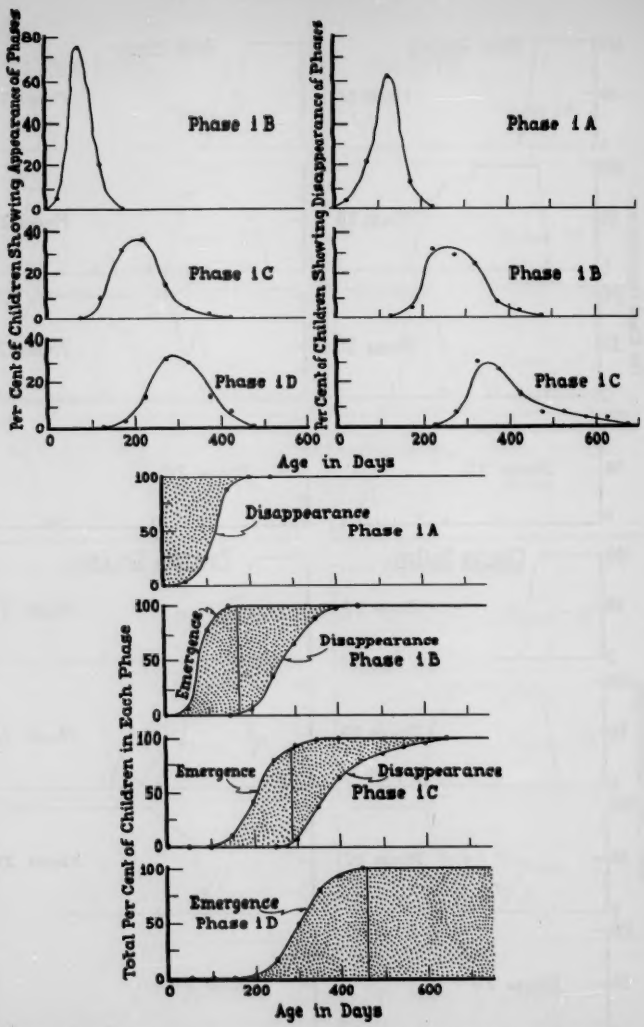

Fig. 4. Distribution curves showing at any age period the percentage of children in whom the (a) emergence and (b) disappearance of each phase of the sensori-motor aspect of the behavior was indicated. The ogives indicate the total percentage of children in whom the emergence and disappearance of each phase of the sensori-motor aspects had been indicated. The dotted area between the ogives indicates the percentage of children at any age manifesting each phase of development.

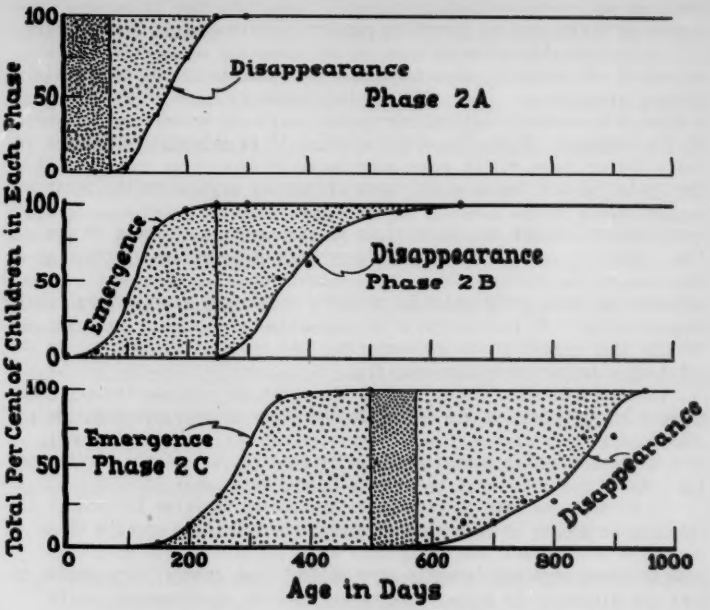

Fig. 5. Ogives showing the percentage of children manifesting each phase of the cognitive and conative aspects of the behavior at any age period.

brain is less well developed structurally than is the motor area in the precentral gyrus. In view of these findings it is reasonable to assume that the sensori-motor reactions of the newborn infant do not extend appreciably beyond the level of the thalamus. Observations on the overt behavior of the infant support this assumption. The cortex is responsible for accurate discrimination of intensities and localization. The newborn infant manifests no ability to localize cutaneous irritation. Reactions represented by Phases 1A and 2A are therefore probably controlled at a subcortical level. The diminution of diffuse bodily movements, represented by Phase 1B, reflects an inhibitory influence of the cortex upon the neuromuscular activities of subcortical centers. This phenomenon has been observed in the development of other neuromuscular activities. It is possible that during the latter part of this phase an inhibitory influence is exerted over the sensory impulses as well, since frequently the children do not cry so intensely as they do later or during the newborn phase. This interpretation is in harmony with the view expressed by Head and Holmes (5), a theory to which some other investigators do not subscribe. Phase 2B indicates object vision, and presumably the functioning of the occipital cortex. However, there is no

evidence that such cortical functioning is at this time in any way connected with the centers governing sensory experience such as pin prick.

It is generally conceded that in the human the cerebral cortex is essential for intensity discrimination and localization of superficial sensory stimulation. The reactions delineated as Phase 1C in this study reflect the onset of cortical participation in the sensori-motor aspects of the behavior. Since the onset of Phase 1C is somewhat in advance of the onset of Phase 2C, it seems reasonable to infer that the cortical relay nuclei of the thalamus and their projection systems to the motor and sensory areas of the cerebral cortex mature somewhat in advance of the associational nuclei and projections to the association areas of the cortex. This interpretation is in harmony with observations on other activities of the growing infant (10), wherein motor aspects of the behavior achieved an appreciable state of maturity before the associational centers became active. In this activity participation of cortical associational centers was evinced about the same time that the ability to localize the point of stimulation became specific.

The development of Phase 2D indicates that the various centers which mediate an appraisal of the situation and evoke appropriate behavior are functionally operative. This ability does not begin to develop until toward the end of the second year and it does not become the predominating mode of response until the middle of the third year.

No attempt was made in this investigation to appraise individual differences in manner of response. However, the situation appears to be one which lends itself admirably to a study of personality qualities. Some children were consistently more stoical than others, some tended to meet the situation by verbal threats against the experimenter, while others expressed a more aggressive motor type of behavior.

SUMMARY

The reactions to pin prick of a group of infants ranging in age from birth to four years were recorded and analyzed in such a manner as to delineate those qualities which are of developmental significance. Repeated observations were made at various intervals, the total number of observations being 2,008. The group data were supported by longitudinal studies of four individual infants during the first 18 and 24 months of life.

Four major phases of the sensori-motor and four phases of the cognitive and conative aspects of the behavior have been described. These changes in overt behavior undoubtedly reflect reorganization of the neural mechanisms involved.

Since the preponderance of evidence from cited histological studies indicates that function of the cerebral cortex at the time of birth is problematical, interpretation of the data was based upon the altogether plausible assumption that the sensori-motor experiences of the newborn infant do not extend beyond the subcortical or thalamic level. Prior to the onset of cortical control over the function there occurs a period of diminished neuromuscular activity, and possibly diminished sensory experience. This period may reflect an inhibitory influence of the cortex upon subcortical neuromuscular functions. It is a phase which has

been detected in the development of other neuromuscular activities common to the growing infant. General localization of the stimulated area is the first distinct evidence of active cortical participation in the function. The inception of localization is indicated only over an extensive area, that is, at the onset of cortical functioning the child is able to identify the point of stimulation only within wide limits. As further cortical development takes place specific localization is exhibited, as revealed by the child's palliative and defence reactions.

In general the sensori-motor aspects of the behavior develop slightly earlier than do the cognitive and conative aspects. That is, the child shows some general localization before he displays signs of recognizing or associating the unapplied stimulus with the disagreeable sensation. Specific localization is well established before the child achieves integration of the various centers which permit adequate appraisal of the situation and a masterful response.

No attempt has been made in the interpretation of these data to identify particular qualities of overt behavior with specific neural structures. However, this analysis of behavior depicts qualities of reactions which reflect major reorganizations of the nervous system, and as such provides a basis for more definite determination of neuro-structural and functional relationships when the maturational processes in neural structures have been adequately determined.

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PARENTS' REPORTS OF UNDESIRABLE BEHAVIOR IN CHILDREN[1]

ALMA LONG[2]

The aim of this investigation was to study parents' reports of undesirable behavior tendencies in their children. It also included reports of methods of discipline used by parents. Variations in pattern were studied with reference to differences in age, sex, ordinal position in the family and also to the age, education of the mother and socio-economic status of the family. The importance of behavior tendencies in the total developmental picture of childhood may be suggested in frequencies of occurrence and also by associations between the tendencies themselves. The general reaction of parents to types of behavior they consider undesirable is also an important factor of the situation in which the behavior occurred.

Problems of similarity and difference in total personality of a child at different age levels may arise to confuse the parent or teacher in dealing with the individual. Environmental pressures and differences in degree of maturation as well underlie this study. It seeks to portray some outstanding characteristics of overt child behavior which were associated with representative age classifications of growing children.

The study is also concerned with the usefulness of parental reports in child study. Parents, with continuous opportunity to observe their children, possess information of undoubted value. Their training and feelings toward the child may perhaps obscure many issues which are important in clinical diagnosis. They may also have become so inured to a particular behavior tendency in the child that they no longer consider the behavior present to any noticeable degree. However justifiable parental ideas of behavior problems in children may be, the disciplinary character of the environment in which the child lives is obviously and directly affected by what the parent thinks is mis-behavior.

An entirely anonymous questionnaire containing fifty-seven descriptions of undesirable behavior and a list of twenty training methods commonly associated with the treatment of such behavior in the ordinary conduct of family life was prepared. Following a trial analysis of reports, a large number of the questionnaires were sent to families in two industrial cities, two small towns and seven rural districts in the middle west. Parents were urged to reply with the utmost candor. To make sure that no comment could in any way reflect upon the child or family, no identifying marks were placed on any form. The materials of the questionnaire also included items describing the family background and the general attitudes of the parents toward the problems of child training.

[1]*This study was carried out under the guidance of Dr. L. Dewey Anderson, Director of Psychological Research of the Developmental Health Inquiry of the Associated Foundations and members of the Department of Psychology of Western Reserve University, 1931-32.*

Grateful acknowledgment is made for the encouragement and assistance so generously given in the attempt to bring together and test some impressions of parent-child relationships which had accumulated over a period of years.

Exigencies of circumstance prevented the immediate publication of the study, planned to accompany a number of contemporary studies in the field of child behavior. It is now presented, with no important change from the original text, except that incident to condensing and the addition to the bibliography of a number of titles of studies which were being informally reported at the time the study was in progress.

[2]*From Division of Education and Applied Psychology, Purdue University.*

The content was suggested by the work of Olsen, Van Waters, Glueck, Ackerson, Foster, Laws, Lowrey, Murphy, Jones and Jones, Fitz-Simons, Wickman, and others and the results of a previous experiment undertaken by the author with a group of parents.

The forms were prepared so that replies might be given by checking or by writing in data concerning behavior tendencies thought to be present at the time (regardless of the intensity or duration of the behavior) and also any type of training method used in treatment. Since there was nothing to be gained by minimizing or exaggerating a fault, or by not being truthful, it was believed that the completed questionnaires were sincere and reliable reports. Those who cooperated in the study were a somewhat selected group, inasmuch as they were reached chiefly through parent-teacher associations and child-study clubs.

Two hundred and seventy-seven families cooperated in the study. They gave records of three hundred and thirty-eight children. In all but eight per cent of the cases, both parents were American born. Three-fourths of all of the grandparents were also native born. The foreign born grandparents originated in twenty countries. Two-thirds of the replies came from urban centers. The living fathers of the children were engaged in eighty-five occupations. The reports used in the study represent children from three to eighteen years of age, eighty per cent of whom were under twelve years of age. The mean age of the one hundred and seventy-one boys was 7.2 years. That of the one hundred and sixty-seven girls was 7.5 years.

The number of siblings per case was:

Siblings	Number cases	Percent	Siblings	Number cases	Percent
None	78	23.0	5	3	.9
1	123	36.4	6	4	1.1
2	62	18.1	7	2	.6
3	47	13.9	8	0	.0
4	17	5.0	9	2	.6

Some characteristics of the family backgrounds described are as follows: The education of the parents is represented by attendance from the fifth grade through to doctor's degrees for the fathers and to the master's degree for the mothers. The median number of years of school attendance was 11.81 for the fathers and 12.08 for the mothers. Ages of parents range from seventeen to fifty-four years. The median age of fathers was 40.13 years. That of mothers was 37.13 years. One-fourth of the living fathers were slightly younger than the mothers. Two-thirds of the fathers were from one to seven years older than the mothers. A few were from nine to seventeen years older than the mothers. The disparity in the ages of parents and children ranges from eighteen to fifty-four years for the fathers and from seventeen to forty-four years for the mothers. The median difference is 30.78 years for the fathers and 28.09 years for the mothers.

The distribution of subjects, of siblings and of the number of behavior tendencies mentioned in connection with the individual children in the families of different size are summarized in Table 1. A very few children were reported as having been subjects of behavior clinic study.

TABLE 1

DISTRIBUTION OF SUBJECTS, SIBLINGS, BEHAVIOR TENDENCIES ACCORDING TO SIZE OF FAMILY

Position in family	Number		Percent total		Subjects with siblings in group	Average number tendencies
	Boys	Girls	Boys	Girls		
Only child	37	41	10.9	12.1		6.2
Eldest in family of:						
2 children	38	37	11.2	10.9	25	6.5
3 children	14	16	4.1	4.7	9	7.2
4 or more	9	8	2.7	2.3	10	6.0
Youngest in family of:						
2 children	28	18	8.2	5.3	22	5.5
3 children	11	12	3.3	3.5	5	7.0
4 or more	13	15	3.8	4.5	9	5.7
Middle in family of:						
3 children	7	5	2.2	1.5	7	5.5
4 children	9	6	2.7	1.8	12	7.4
5 or more	5	9	1.6	2.7	9	9.4
Total			50.7	49.3		

A few parents indicated that they had studied child development in school. The majority of them represent families which have had only informal training in the subject or have been interested in the education offered through child-study and parent-teacher organizations. Among families where there were two or more children, one hundred and fifty-one reported on one child only. Forty-eight families reported on two or more of their children. There were reports of seventy-eight only children.

Percentage distributions were calculated for each of the items to which parents responded. Relative frequencies for items recorded as present in the entire group and among the individuals of the several age classifications were compared. It is not assumed that the behavior items described are mutually exclusive. There are probably common elements in many of them. It is probably true also that some basic behavior trends in the same child may be described in different terms when they are associated with different age levels. This would necessarily modify the interpretation of certain coefficients of inter-correlation and the description of specific age trends. Further studies might contribute much in a further clarification of terminology commonly employed in describing child behavior. The terms used in this study are those which seemed to be familiar to and readily used by parents who have had a minimum of specific training in psychological interpretation and implications of behavior phenomena.

The central theme of each phrase used to describe behavior items and the proportions of the entire group of whom the items were reported present are given in Table 2.

Two forms of the questionnaire were prepared in which the items for response were arranged in different random orders. There was no significant difference in the distribution of replies on the various items when so arranged. It was believed that age factors might bear an important relationship to the frequencies of occurrence of the behavior tendencies. The reports were therefore divided into groups which roughly represent

TABLE 2

PERCENTAGE DISTRIBUTION OF BEHAVIOR TENDENCIES

Serial Number	Description	Percent	Serial Number	Description	Percent
1.	Disobedience, argue over situation	41.4	19.	Lack initiative	10.0
34.	Dawdling	30.0	12.	Critical of others	9.4
18.	Habitually wilful	27.8	54.	Persistent bad table manners	9.1
50.	Resist suitable bedtime	22.0	5.	Quarrelsome	8.8
28.	Capricious	21.3	52.	Habitual lack of appetite	8.5
25.	Cry easily, whine	21.0	21.	Cling to baby habits	7.6
14.	Defiance, continued refusal	20.3	13.	Non-cooperative	7.3
51.	Bad food habits	19.8	15.	Habitually irritable	7.0
8.	Uncontrolled temper	19.5	43.	Lie, evade truth, conceal facts	7.0
27.	Easily discouraged	19.5	38.	Dissatisfied with home	6.7
6.	Impudent talking	19.5	48.	General nervousness	6.0
36.	Jealousy	19.2	44.	Cruelty	5.6
29.	Nervous habits	18.9	31.	Bed-wetting	5.0
26.	Seek over-much attention	18.3	33.	Generally untidy	5.0
55.	Overly conscientious	16.8	41.	Get into undesirable company	5.0
10.	Resentful, antagonistic	16.3	56.	Work hard, not able to keep with group	4.4
11.	Generally selfish	15.3	16.	Bad or vulgar language	3.8
35.	Fearful of many things	13.5	42.	Stealing, sneaking	3.1
30.	Thumb or finger sucking	12.4	23.	Too repressed	2.9
3.	Habitually stubborn	12.1	37.	Hostile, suspicious	2.6
24.	Pretend things difficult	11.8	32.	Soil self in daytime	2.3
49.	Easily disturbed	11.8	57.	Poor sense of money value	2.3
40.	Efforts below ability	11.5	44.	Smoking	2.1
7.	Rough, boisterous	11.2	53.	Vomiting, not due to physical cause	2.1
20.	Avoid responsibility	10.9	47.	Over-interest in opposite sex	1.8
17.	Excessively mischievous	10.6	39.	Truancy	1.8
22.	Too restrained	10.3	45.	Excesses due to drinking	.9
2.	Temper tantrums	10.0	46.	Bad sex practices	.9
9.	Overly self confident, boastful	10.0			

the later pre-school years, entrance to school, the early grades in school, the pubertal period and adolescence. The frequencies with which each item of behavior was reported as present in any of the children of each age group were recorded as percentages of those groups.

In some instances, no significant difference between distributions in these age groups could be found. The items which were mentioned with similar relative frequency in all of the age groups are: To be habitually stubborn, cruel, to pick a fight, to be impudent, to be rough or boisterous, to have an uncontrolled temper, to be resentful. to be selfish, to be non-cooperative, to be defiant, to be excessively mischievous, to lack initiative, to cling to baby habits, to be too repressed, to pretend things too difficult, to be capricious, to have nervous habits, to have bad toilet habits, to be jealous, to be hostile or suspicious, to be dissatisfied with the home, to play truant, to go in undesirable company, to steal or sneak, to lie or evade truth, to smoke, to drink liquor, to practice bad sex behavior, to exhibit over-interest in opposite sex, to be restless, to have bad food habits, to vomit without physical cause, to have bad table manners, to fail to keep up with own group, to have no idea of money value.

Some of the afore-mentioned items were indicated as present in only a small portion of the cases reported. They may represent types of

behavior which are more annoying than serious. They may also represent profound emotional disturbances, the importance of which may hinge upon their sudden appearance or their continuance, subtle and confusing symptoms, the extent to which some attitude permeates many phases of the child's activity, and also the disturbance caused in the family group. Such facts point to the usefulness of long time records of the persistence of behavior traits in dealing with the symptoms recognized. The children of this study group were in all but a very few exceptions not subjects of professional clinical diagnosis. If the symptoms reported indicate need for such services, the great need for better understanding by parents of those aspects of child behavior which are agreed to be indicative of profound disturbance is obvious.

The frequency with which a behavior tendency is likely to be observed in a large group of children may be important. It is much more important to the individual child and to his parents that the general history of phases of such behavior phenomena be known. Appearance and disappearance, crises, form, factors contributing to intensity, results of disciplinary method employed, differentiation between obvious or intentional misbehavior and the types of experimental, mobile trial and error behavior which is characteristic of growth occupy an important place in the thoughtful direction of child behavior. That some phases of child behavior wax and wane suddenly, that others build up to a climax over a period of time to disappear suddenly, or to remain as a permanent characteristic is well known. Some differences in the rise and fall of frequencies in the several age groups of this study bear mute evidence to these facts. Also, the occurrence of some types of behavior in all age levels, however infrequently they were met, suggests that factors other than age contribute heavily to their presence.

The frequency distributions for items in which significant differences were found for several age groups may be interpreted as saying that if the behavior described is found in a child, it may possibly follow some of the general aspects of the appearance and disappearance outlined. Due allowance must be made for individual variability and also for the effects of disciplinary measures or other treatment given the child. There is no suggestion that any particular behavior tendency will occur because of age or other conditions which were mentioned in the reports analyzed.

A list of those behavior items in which there was a significant difference in distribution in favor of one age group as compared with other age groups is given in Table 3. Graphs which portray the trends in these distributions in comparison with the combined averages of all frequencies for each of the age groups also follow.

Conflict between parent and child is suggested in the frequencies with which some typical behavior aspects were reported of children in the several age groups. For instance, the youngest children were frequently described as disobedient or dawdling or both. The frequency of reports of dawdling for each of the successive older groups was much less. Whether this type of behavior actually does disappear as children grow older, whether this type of unsatisfactory behavior occurred because the parents of the children had expected too great proficiency from them, or whether that which seems to be dawdling in the child of

TABLE 3

PERCENTAGE OF CHILDREN IN EACH AGE GROUP WHO POSSESSED BEHAVIOR TENDENCIES IN WHICH THE FREQUENCIES OF DISTRIBUTION BETWEEN SOME GROUPS ARE SIGNIFICANTLY DIFFERENT

	Behavior	Age group, in years 3-5	5-7	7-10	11-14	14-18
1.	Disobedience	46.6	52.6+	39.8	33.3	28.0-
2.	Temper tantrums	24.4+	10.5	9.7	5.6	4.0-
9.	Boastful	6.7	3.9-	11.5	18.5+	12.0
12.	Critical	6.7	3.9-	11.5	18.5+	8.0
15.	Habitually irritable	2.2-	5.3	11.5+	11.1	12.0
16.	Bad or vulgar language	4.4	0.0-	5.3+	1.8	8.0
18.	Wilfulness	17.8-	29.0	39.8+	22.2	12.0
20.	Avoid responsibility	0.0-	6.6	11.5+	24.1+	12.0+
22.	Shy, uncommunicative	0.0-	7.9+	7.1+	20.4+	20.0+
25.	Whine	24.4+	30.3	24.8+	18.5	4.0-
26.	Seek attention	28.9+	15.8	20.3	18.5	6.0-
27.	Easily discouraged	8.9-	11.8	24.8+	27.8+	22.0
30.	Thumb sucking	20.0+	10.5	13.3	5.6	2.0-
31.	Bed-wetting	17.8+	9.2	2.6-	1.8	0.0
33.	Untidy	0.0-	5.3	7.1+	5.6	6.0
34.	Dawdling	44.4+	46.0+	22.1+	8.0+	0.0-
35.	Many fears	11.1	14.5	23.0+	7.4-	10.0
40.	Efforts below ability	0.0-	7.9+	11.5+	24.1+	16.0+
49.	Generally nervous	6.7	10.5-	17.7	11.1	14.0
50.	Resist bedtime	13.3	11.8-	22.1+	43.6+	20.0+
52.	Lack appetite	13.3	17.1+	7.1	7.4	4.0-
55.	Overly conscientious	4.4-	15.8	18.6+	37.8+	14.0

\- indicates significantly low frequency
\+ indicates significant increase in frequency

three is really part of an integrated and accepted pattern of personality in older children is not known. Nor do we know what the actual results of social or family pressures toward getting a task completed may be for children who do seem to require continuous urging. Lack of pressure, pressure at the wrong time, or too much pressure at any time may be equally disastrous.. Whatever behavior the parents of this study considered disobedience was still present in some of the adolescent youth. More than a fourth of the children of this group failed to comply with or resisted the wishes of their parents even into the later adolescent years. See Figures 1 - 6.

The behavior tendencies which were most frequently reported of children three to four years of age (capriciousness, bedwetting, seeking attention, thumb sucking and temper tantrums) are quite clearly those associated with immaturity. Natural short span of attention, the gradual nature of growth in the control of excretory functions, the need of a feeling of security and partial understanding by children of the usual complex directions given them by adults are characteristic of the young child. If parents are not completely informed of the general pattern of growth in such tendencies, experimenting with behavior control may be costly.

Whining and impudent talking were reported more frequently of those children who had recently entered school than they were of other children. Induction into a new environment, into a new set of requirements

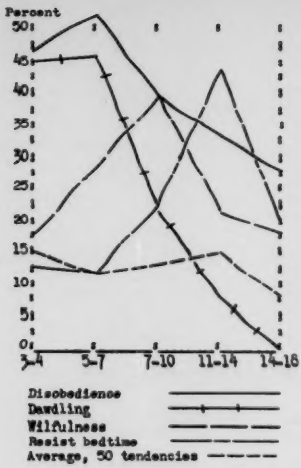

Fig. 1. Highest, all groups.

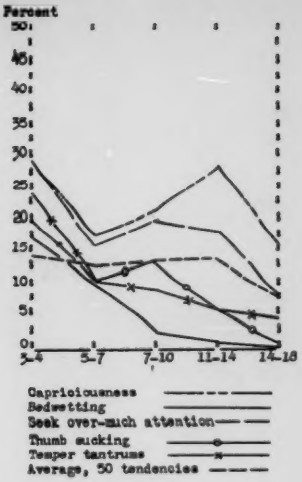

Fig. 2. Most frequent at 3-4 years.

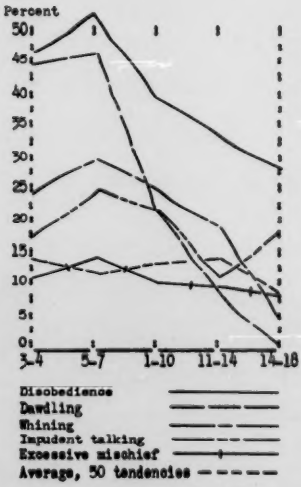

Fig. 3. Most frequent at 5-7 years.

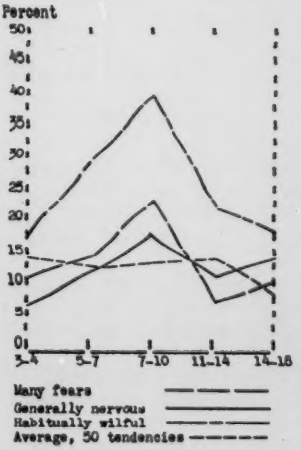

Fig. 4. Most frequent at 7-10 years.

FREQUENCIES OF OCCURRENCE OF BEHAVIOR TENDENCIES

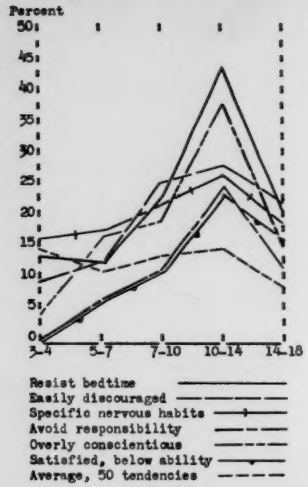

Fig. 5. Most frequent at 11-14 years.

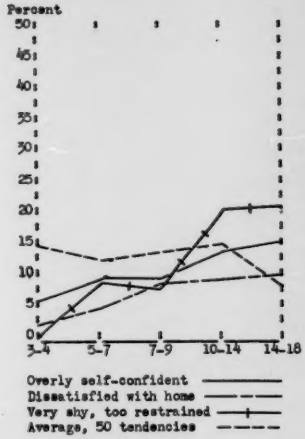

Fig. 6. Most frequent at 14-18 years.

and competitions without the familiar or protective aspects of the home from which the child came might easily result in such aspects of behavior. Judging from the number of instances in which such behavior was reported as present in the children who were just starting to school, many parents are perhaps unable to plan or do not see the necessity of planning with the child and teachers for the situations which are so difficult for the child to understand.

The next older age period is also characterized by a high frequency of reports of behavior which is symptomatic of struggle taking place in the child. Wilfulness was reported of a significantly higher percentage of children who were seven to ten years of age than of either the younger or older groups. Still inexperienced in socially acceptable ways of getting what they desire, one-half of them resorted to overt wilful behavior or stubbornness. The precipitate drop in frequencies reported of the next older group suggests the effect of experience in reducing the number of instances in which a child is likely to resort to this type of disturbing behavior.

A relative increase in the frequency of mention of irritability, of being easily discouraged and having fears for this (seven to eleven) age group also suggests the difficulties which children experience in orienting themselves to multiplying new experiences. Jersild and Holmes describe many types of fear situations experienced by younger children. This study, in hand, of parental reports suggests that such fears and imaginings extend well into the prepubertal period for a very considerable

number of children. Modern thrillers in popular reading materials, movie, radio program, in addition to the general aspects of speed and unrest which characterize everyday life, add something to the severity of the situation for some children and to the need for parental understanding and counsel.

One type of undesirable behavior, resisting bedtime, reported of the children who were from eleven to fourteen years of age reflects the normal increase in interest in social living. At the same time there was an increase in the number of reports of selfishness and shyness. Some children at that age also tend to avoid responsibility and to be easily discouraged. The children of this age group were inclined to resist bedtime in highly significant proportion. No suggestion was given as to what hour was considered proper for these children. However, the importance of item in this study lies in the character of the problem with which parents must deal. Conflict between physiological needs and social desires of the children and parents' belief of what is a suitable plan for satisfying both may be difficult to resolve.

Personality traits which resulted in undesirable behavior were also indicated of early adolescent age (eleven to fourteen). More than one-third of them were described as being overly conscientious, one-fourth as tending to avoid responsibility, and one-fourth as being satisfied with efforts far below their evident ability. About one-fourth were reported as having nervous habits. About the same number were described as being easily discouraged. The relative frequencies with which the several items were reported of children in any age group may be important in the total estimate of the number of children affected. Greater importance should be attached to the nature of the types of behavior which stand out in contrast to the general background of child behavior represented in the composite average occurrence of all of the items reported of all of the children in the several classifications.

Few indications of seriously unsatisfactory behavior among the adolescent children were given. They were said to have, however, a very fair share of behavior tendencies which seemed to be scattered throughout the several age groups. It may be that the undesirable behavior which had been part of the growth pattern of these youth had really disappeared. It is also possible that in the passage of time, parents become so inured to the responses of their children that in many instances they no longer consider the behavior present, or they have accepted the response as part of a fixed personality pattern. One characteristic (being overly self-confident) was reported with frequency enough to be significant. This may reflect not only the adolescent desire for freedom to try his wings, but also the parents' feeling of loss of control over their children and the satisfactions which come with nurture of those who are dependent.

Sex Differences

No significant sex differences in the total frequencies of behavior tendencies ascribed to boys and girls were found. There were a few significant sex differences in distributions within age groups. More boys than girls three to four years of age were described as being hostile and suspicious. More girls than boys of that age were described as being wilful. More girls than boys who were seven to ten years of age were

described as being disobedient, and also as being overly conscientious. More boys than girls of that age were described as being easily angered or having uncontrolled tempers.

Ordinal Position in Family

Many investigations which use findings of clinical studies disclose distributions or attributes characteristic of children placed in the several ordinal ranks of the family. H. E. Jones, Rosenow and Whyte, J. Levy, B. B. Weill and others have presented much illuminating data on the subject. Wile and Noetzel, however, conclude from their study that order of birth is not demonstrated to have an important relation to the development of maladjusted personalities.

The study at hand dealt with non-clinic cases. Few differences in the distributions of undesirable behavior tendencies reported by parents were associated with ordinal position of the child, except as the particular behavior tended to be characteristic of young children or with a few individuals who were "middle" children of large families.

The "only" children were reported less frequently than others as resisting bedtime. The proportions of the group classified in the several ordinal positions are: Only child, 22.2 per cent; Eldest, 37.0 per cent; Middle, 13.6 per cent; and, Youngest, 27.2 per cent. There were only 337 children in the entire group. It is believed that a more extensive study would reveal types of information not disclosed in this one. It is also possible that some parents are not particularly conscious of slight differences in aspect or intensity of behavior manifestations, which at times become phenomena for clinical observation.

Differences Related to Age, Education of Mother and Socio-Economic Status of the Family

The education and socio-economic status of the families which contributed to this study was somewhat above the average of American population. The mean disparity between age of mother and child was 28.09 years. To be quarrelsome and to be wilful were reported with significant frequency of those individuals whose mothers were more than twenty-eight years older than the child. There was a significantly low frequency of stealing or sneaking reported among those children whose mothers were less than twenty-eight years of age at the birth of the child. If children respond better to young mothers, or if the multiple responsibilities which crowd upon the older mothers account for these differences, there appears to be some significance in the idea that younger women tend to deal with growing children most effectively.

Uncontrolled temper, antagonistic or resentful attitudes, resisting bedtime and excessive mischief were reported more frequently of the children whose mothers did not attend school beyond graduation from high school than among those whose mothers had attended college. Habitual stubbornness, excessive mischief, bad table manners and being satisfied with efforts below real ability were reported more frequently of children whose families were rated below the median of the group than among those whose families were rated higher. Obviously, the children from favored homes start with definite advantages. The distributions of undesirable behavior suggest, however, that even within the limits of variability in standards and interpretation attributable to education or

LONG: UNDESIRABLE BEHAVIOR

TABLE 4 - PART A

TETRACHORIC CORRELATION COEFFICIENTS OF BEHAVIOR TENDENCIES REPORTED 50 OR MORE TIMES

	Dawdling	Wilfulness	Resist bedtime	Capriciousness	Whining	Defiance	Uncontrolled temper	Easily discouraged
Disobedience	.27	.29	.25	.33	.27	.01	.05	.01
Dawdling		.04	.15	.18	.11	.04	.24	.21
Wilfulness			.09	.23	.32	.26	.39	.05
Resist bedtime				.03	.01	.35	.15	.10
Capricious					.16	.27	.04	.03
Whining						.15	.15	.03
Defiance							.35	.20
Uncontrolled temper								.21
Easily discouraged								

	Impudent talking	Jealousy	Nervous habits	Bad food habits	Seek attention	Over conscientious	Resentful	Selfish
Disobedience	.49	.11	.01	.36	.16	.20	.29	.38
Dawdling	.21	.10	.03	.25	.06	.17	.02	.13
Wilfulness	.20	.30	.03	.15	.37	.32	.37	.02
Resist bedtime	.10	.16	.16	.26	.13	.01	.24	.02
Capricious	.10	.08	.22	.31	.43	.01	.19	.06
Whining	.01	.12	.13	.16	.32	.08	.20	.00
Defiance	.20	.39	.18	.29	.34	.11	.45	.39
Uncontrolled temper	.19	.36	.24	.16	.19	.12	.65	.28
Easily discouraged	.12	.23	.33	.00	.42	.16	.05	.25
Impudent talking		.11	.06	.18	.15	.14	.29	.20
Jealousy			.10	.13	.13	.00	.28	.24
Nervous habits				.06	.10	.38	.21	.05
Bad food habits					.06	.05	.10	.28
Seek attention						.43	.24	.20
Overly conscientious							.11	.09
Resentful, antagonistic								.24
Generally selfish								

Note: Arranged in descending order of frequency.

TABLE 4 - PART B

TETRACHORIC CORRELATION COEFFICIENTS OF BEHAVIOR TENDENCIES REPORTED 37-49 TIMES - AVERAGES OF INTERCORRELATION

	Many fears	Thumbsucking	Stubborn	Pretend difficult	Generally nervous	Efforts below ability	Rough, boisterous	Avoid responsibility	Average
Disobedience	.07	.02	.33	.10	.24	.22	.32	.14	.16
Dawdling	.14	.32	.26	.48	.12	.03	.29	.03	.03
Wilfulness	.16	.03	.23	.58	.08	.18	.02	.06	.13
Resist bedtime	.20	.12	.14	.10	.19	.16	.38	.14	.03
Capricious	.26	.10	.28	.17	.25	.42	.19	.20	.08
Whining	.15	.06	.25	.31	.22	.18	.11	.09	.10
Defiance	.32	.08	.41	.12	.12	.15	.30	.03	.19
Uncontrolled temper	.09	.18	.44	.25	.25	.17	.08	.24	.20
Easily discouraged	.30	.18	.05	.38	.49	.26	.03	.24	.10
Impudence	.00	.27	.28	.25	.10	.07	.23	.21	.07
Jealousy	.23	.05	.11	.04	.07	.22	.02	.20	.13
Nervous habits	.35	.00	.06	.13	.54	.23	.10	.00	.11
Bad food habits	.32	.11	.11	.17	.26	.08	.15	.13	.11
Seek attention	.18	.17	.23	.15	.45	.21	.07	.07	.21
Over-conscientious	.25	.14	.20	.21	.21	.06	.38	.14	.14
Resentful	.21	.27	.44	.49	.08	.19	.15	.27	.24
Selfish	.25	.14	.20	.21	.21	.06	.38	.14	.14
Many fears		.08	.09	.21	.41	.11	.23	.07	.18
Thumb sucking			.08	.19	.14	.08	.38	.05	.02
Stubborn				.31	.31	.38	.16	.17	.15
Pretend difficult					.15	.05	.23	.36	.20
Generally nervous						.16	.13	.24	.16
Efforts below ability							.24	.31	.13
Rough, boisterous								.16	.13
								Total Average	12.0

economic advantage, some parents in all classes are confronted with difficult behavior problems in their children.

Relationships Between Behavior Tendencies

Tetrachoric coefficients of correlation were computed to determine the degree of likelihood that any two behavior tendencies would appear together. The twenty-five items which had been reported with the greatest frequency were selected for this comparison. They were classified as (A) those which had been mentioned at least fifty times and (B) those which had been mentioned from thirty-seven to forty-nine times. The coefficients calculated range from -.43 to +.65. The average intercorrelations of any one of these items with the other twenty-four items range from +.01 to +.24. The composite average of all the intercorrelations between frequencies is +.12.

The coefficients of correlation suggest that while behavior tendencies may have some slight relationship with each other, there is a much greater likelihood that any of the behavior tendencies will be found in

TABLE 5

SOME DEGREES OF CORRELATION BETWEEN FREQUENCIES OF BEHAVIOR TENDENCIES REPORTED AS JOINTLY PRESENT

	Tetrachoric r
Coefficients +.60 or more:	
Uncontrolled temper and resentful behavior	.65
Coefficients +.40 to +.59:	
Wilfulness and pretending too difficult	.58
Nervous habits and general nervousness	.54
Disobedience and impudent talking	.49
Resentfulness and pretend too difficult	.48
Dawdling and pretend too difficult	.48
Defiance and resentfulness	.45
Seek over-much attention and general nervousness	.45
Stubbornness and uncontrolled temper	.44
Capriciousness and seek over-much attention	.43
Over-conscientiousness and seek over-much attention	.43
Capriciousness and efforts below real ability	.42
Easily discouraged and seek over-much attention	.42
Stubbornness and defiance	.41
Easily discouraged and general nervousness	.41
Having many fears and general nervousness	.41
Overly conscientious and general nervousness	-.46

highly variable constellations. The pattern of behavior in any child will vary not only in the integral parts, but also in the time at which and the intensity with which the several aspects may operate. The highest intercorrelations occurred in connection with behavior described as being resentful. The lowest occurred with being overly-conscientious. Since many of the descriptions of the behavior tendencies are not mutually exclusive, even lower average correlations would doubtless result from the study of exactly defined data. Any child behavior pattern must be considered in terms of its variants, in terms of the intensity of the various components, and in terms of the probable duration before conclusions can be drawn about it. The above Table No. 5 outlines the highest degrees of tetrachoric correlation found in the distributions.

Multiple Relationships

The extent to which patterns of behavior extend themselves in different children was illustrated in the reports of a few cases. Many more cases, and much more detailed analysis would be necessary to establish the fact of existing bonds. The data are given for any value they may have in suggesting problems for further study.

Of thirty children who had been described as resentful and also as easily angered, sixteen were also described as being defiant. Of these sixteen, ten were described as talking impudently to adults or children. Of these ten, five were also described as jealous. Ten of the thirty were described as jealous and of these, five were also described as generally selfish.

Of seventeen children described as pretending things difficult and also as being resentful, nine were described as being wilful, "Poor sports." Of these nine, four were also described as being easily discouraged.

Of fifteen children described as seeking over-much attention and also

as being overly conscientious, nine were described as being easily discouraged. Of these nine, three were also described as wilful, "Poor sports."

Of thirteen children described as pretending things difficult and also as dawdling, five were also described as being resentful. Of these five, four were described as talking impudently to adults or children.

The above are probably patterns of behavior more or less commonly observed by those engaged in dealing with growing children. They may be more or less obscured by the presence of other behavior traits. In all of these instances mentioned above, several additional tendencies had been recorded. It would seem, therefore, essential to the task of diagnosis and prognosis of child behavior that suitable techniques for cataloging and analysis of behavior patterns be developed. The importance of objective analysis and evaluation of child behavior for those whose responsibility it is to guide and direct, to encourage and discipline over a formative period can hardly be overestimated.

Results of the comparison suggest some similarities in the elements of behavior items described in the questionnaire. These merit further analysis and clarification for more descriptive terminology. Relationships found between behavior tendencies which resulted in different age distributions attest also to the need for additional information in this field.

Parents' reports of behavior tendencies present in their children have been studied to find significant trends in distribution. The character of the population represented is somewhat above the general average with respect to education and socio-economic status. At the time the reports were made, the children were considered by their parents to possess a varying number of the behavior traits mentioned in the questionnaire. A small number were considered to have none, 80 per cent of the children were considered to have from one to ten, and some were considered to have as many as twenty or more of the behavior traits. The frequencies of individual behavior tendencies reported range from .9 to 41.4 per cent of the entire group. No tendencies described failed to be mentioned as being present in some child.

When the reports were classified according to social-age groupings, the average number of tendencies per child reported of each of the four younger groups were almost identical. The number ascribed to the adolescent group were somewhat smaller.

There were few sex differences. The similarities in percentage distribution are so much more numerous than the differences that it is justifiable to disregard sex in the general analysis of behavior tendency frequencies.

Marked differences in distribution according to age were found. Ascending and descending curves of distribution with increasing age suggest that many behavior attributes are possibly related to factors of physical growth and social experience. They are probably directly affected by factors in the immediate environment and by practices in child training which are common to American families. Within the population represented by this particular group, very few differences of behavior tendencies could be associated with factors other than differences in age. A small incidence of report of behavior tendencies which are considered

evidence of serious maladjustment has been found. Terms describing behavior may be subject to varied interpretation as age of the child varies and as parents become more and more accustomed to or more understanding of the particular behavior manifestation. Delineation of the basic trends in child behavior and clarification of terminology would be most beneficial to the study of child behavior.

Insofar as parents have been able to observe and record the behavior of their children, the accustomed experience of a large number provides adequate proof of important age differences in the behavior of children. The multiform quality of the behavior patterns observed by parents and the low degrees of relationship between the several items of behavior reported indicate that each child presents a unique problem. Treatment to be given for any single aspect of behavior must be considered with reference to a composite whole.

Child-Training Methods

After many interviews with parents, twenty methods of behavior treatment commonly used were described in the questionnaire. Those who contributed to the study were asked to indicate any type of discipline they used in connection with any behavior items mentioned in the report of the child. The notes added were classified with those types of discipline they most nearly represented, inasmuch as the descriptions were all somewhat general.

Parents reported disciplinary methods generally used with their children. They also gave accounts of methods tried in the treatment of 1228 specific behavior situations involving 180 children. These more detailed reports were arranged to find the relative importance of the several types of discipline mentioned by the parents in dealing with the behavior tendencies. The percentage distributions are found in Table 6.

The method described as reasoning at length with the child was mentioned more frequently than any other. Scolding, telling the child emphatically what he must do was mentioned only one-third as often as reasoning was mentioned. Since it is extremely easy to permit emotional behavior to change the character of a supposedly logical discussion, it was assumed that the two categories might be combined in the analysis of the data without disadvantage.

The next most frequently mentioned methods were: to ignore the child and to let him choose his own course; to cause the child to feel ashamed of his behavior; and to reward, praise or promise favors. Three methods which were mentioned with almost identical frequency are: To make special effort to cultivate companionship with the child; to take special precaution, as to remove the child from the situation, prepare in advance, and, to substitute another activity. To treat the situation as unimportant, to send the child to his own room until willing to obey, to deprive the child of some desired object, to make sport of the situation and other methods were mentioned with lessened frequency.

When some reports were classified with reference to the character of behavior being treated, some significant findings resulted. In 65 instances where the behavior was that associated with immaturity of childhood (dawdling, thumb-sucking, bedwetting) 30 per cent were reported as being treated with scolding, 35 per cent with reasoning at length, and 25 per cent with rewards for good behavior.

TABLE 6

DISTRIBUTION OF CHILD-TRAINING METHODS REPORTED IN CONNECTION WITH 48 BEHAVIOR TENDENCIES

Method Number	Description	Percent
9	Reason at length with child, and	41.3
4	Scold, tell child emphatically what he must do	12.0
1	Ignore completely, let child choose his own course	11.3
5	Make child feel ashamed of his behavior	10.9
14	Reward, praise, promise extra favors	9.0
17	Make special effort to cultivate companionship with the child	9.0
15	Take special precaution, as to remove child from the situation, prepare in advance	8.5
11	Substitute other activity	7.1
16	Treat situation as unimportant	6.9
7	Send child to own room until willing to obey	6.8
3	Punish by spanking	5.7
6	Deprive child of desired object, toy, dessert, etc.	5.2
2	Make sport of situation, laugh at child	4.0
10	Watch but not interfere with situation	3.5
20	Make child sit quietly in chair, separated from the group	2.6
12	Use physical means, as putting child in bed	2.3
8	Exact penalty for offenses	1.6
13	Use severe measures of punishment	1.3
18	Send child to bed	.5
19	Put child in dark room	.4

In 86 instances involving too great dependence on adults (seeking over-much attention, being easily discouraged) 39 per cent were reported as being treated with reasoning at length, 20 per cent with each of the following: substituting other activities, reward for good behavior, special effort to cultivate comradeship. A few of these were reported as being ignored, or as being treated as if the behavior were unimportant.

In 86 instances where the family routines were obviously disturbed (boisterousness, uncontrolled temper, bad food habits, bad table manners, impudent talking) 31 per cent were reported as being treated with reasoning, 19 per cent as being ignored, 14 per cent by being scolded, and 12 per cent by sending the child to his room.

In 92 instances of presumable nervous instability (capriciousness, nervous habits, restlessness, vomiting, avoiding responsibility) 28 per cent were reported as being treated with reasoning, 20 per cent with special efforts to cultivate comradeship, and 12 per cent with special precaution to prevent bad situations.

In 122 cases probably associated with profound emotional disturbances (jealousy, fears, shyness, temper tantrums, boastfulness, resentfulness, whining, stubbornness) 38 per cent were reported as being treated with reasoning, 21 per cent with causing the child to feel ashamed of his behavior, and 11 per cent as making sport of the situation. Spanking, scolding and treating the situation as if unimportant were also mentioned. In all of the above categories, other types of training were mentioned a small number of times.

Obviously, the children of this group had been treated with a considerable freedom from harsh or forceful discipline. The parents had,

on the other hand, failed to make very extensive use of some methods of training thought to be psychologically sound. Social approval or disapproval, re-direction of energy, careful study of the interests and abilities of the child, the cultivation of suitable attitudes toward things required, etc. do not appear to have held a prominent place in the patterns of training reported. If the parents who contributed to this study are above the average, as their reports would indicate, these findings suggest the great need for parents to be generally better informed about the development of behavior in children.

No significant differences were found to indicate selective training methods considered more suitable for children of different ages or sex, although there seemed to be a lessened frequency with older children of methods of coercion and of depriving the child of some object. The importance of cultivating comradeship was expressed more frequently also in the reports of older children. There was also no significant difference in distribution of training methods utilized by families of different socio-economic levels. More of the younger mothers reported the use of reasoning at length than did the older mothers. More of the mothers whose number of years in school were above the median of the group than those below it reported the use of: substituting another activity, depriving a child of some desired object, treating the situation as unimportant; taking special precaution to prepare the child in advance and to remove the child from a bad situation. These comparisons suggest that boys and girls were being treated with the similar disciplinary measures, that economic status does not affect the types of parental control, but that education does affect at least some of the practices of parents in child training.

SUMMARY AND CONCLUSIONS

Parents' reports of the behavior tendencies present in children from three to eighteen years of age have been studied. The nature of the investigation was exploratory, to gather information concerning the behavior problems in children with which parents are particularly concerned, to determine relationships with the age and sex of child, with the age and education of the parents, and with the socio-economic conditions of the family and training methods employed. The results indicate trends and tendencies in child behavior found among a varied American population.

A group of parents expressed their views of undesirable behavior tendencies present in their children. Despite the fact that equal numbers of questionnaire forms were distributed among families in which there were older and younger children, 80 per cent of the replies were concerned with the behavior of children under 12 years of age. Fifty per cent of the reports were of children from five to ten years of age. In distributions of individual behavior tendencies, high frequencies occurred among children classified in several age groups.

Curves of distribution which associate types of behavior particularly with various age levels suggest that:

1. There is a definite characteristic of child behavior associated with age.
2. Changes in frequency associated with differences in

age may be due to an actual appearance, non-appearance or disappearance of the behavior, to a differing interpretation of the behavior, or to some negative conditioning on the part of parents which is essential to the peaceful conduct of the home.

Regardless of the presence or true non-presence of the behavior, child-parent relationships are by nature modified by the parents' belief in the condition. It is therefore important that account be taken of child behavior as viewed by parents.

Behavior tendencies most frequently recorded of the children in the youngest group were those ordinarily associated with early childhood, such as temper tantrums, seeking much attention, bed-wetting, thumb sucking and dawdling. Disobedience, whining, and a continuation of dawdling characterized the group 5-7 years of age.

Children 7-11 years of age tended to exhibit a lessening proportion of the behavior tendencies most frequent among younger children and to add an array of responses indicative of their inadequate techniques for entry into a rapidly expanding experience. They tended to be frequently irritable, wilful, easily discouraged and to have many fears.

Children of the pre-pubertal period tended more frequently to be selfish, shy, to avoid responsibility, to be easily discouraged also, to be overly-conscientious and to be satisfied with mediocre products of their industry. They delayed going to bed.

Adolescents tended to be less disobedient than younger children, and to have a lessened frequency of many other behavior tendencies ascribed to the younger groups. They had, however, a very fair share of behavior tendencies which seem to be scattered with no decided peaks of frequency throughout the younger groups. These varied results appear to define some characteristics of social growth in childhood and also to direct the attention to types of behavior suggestive of permanent personal characteristics.

Many positive correlations and some negative correlations between frequencies of the behavior traits described suggest the feasibility of further inventorying behavior of children for the clarification of behavior patterns. There is marked evidence that behavior tendencies do not show high relationships with one another in regard to presence or absence. That is, a child who displays one undesirable trait may or may not display others. This seems to indicate that good or bad behavior is not a general characteristic. This is important to the educator since it indicates that tendencies should be treated in much the same manner that a physician handles specific physical ailments. Since some subjects revealed patterns of behavior in which the elements were similar, much greater value could be gained from more extensive and intensive studies of possible relationships or lack of true relationship.

Child-training methods employed by parents as revealed in the reports indicate an important frequency of discussion of behavior and problems with the child and a relative infrequency of physical coercion. Scolding, ignoring, praising, guarding, bribing, preparing the child in advance and other methods of child-training were mentioned in much smaller proportion than "reasoning". The high frequency of "reasoning" is probably closely related to an equally high frequency of disobedience characterized by refusal, argument, delay. If such is the case, it seems advisable to

secure a better general understanding of the child's behavior and also an improvement in parental techniques in dealing with behavior manifestations.

Advantageous educational and socio-economic position seem to be associated with a low frequency of seriously maladjusted behavior, but do not eliminate a very considerable array of behavior difficulties in children. Some superior parents, in terms of enlightened child behavior treatment, were found among those who had not enjoyed educational advantages. Educational advantages are reflected somewhat, but not to an optimum extent, in a greater frequency of use of several child-training methods known to be productive of good results. It then appears that successful parenthood is entirely independent of material possessions. It may be greatly facilitated by the presence of general intelligence and understanding of the specifics of child development. Suitable information adequately dispensed would likely result in permanent good wherever earnest, intelligent parents find it accessible.

Since child-training is primarily a function of home and parenthood, solution of the many problems must come through enlightenment of those most directly concerned with its responsibilities.

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THE RELATION OF FETAL ACTIVITY TO THE ACTIVITY OF THE MOTHER

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There has been a great deal of excellent experimentation on the problem of the development of embryonic movements in lower animals and even in man. The changes in fetal behavior, in the human, in response to a changing fetal environment, have however had very little investigation. The author has been able to find only one reference to the effect of maternal activity on the activity of the fetus: in the course of a study of the basal metabolic rate (3), the material "fails to show significant differences in activity thus reported which may be due to.....maternal activity." Using another procedure, such differences were found here.

PROCEDURE

The author acted as subject in the present experiment. The typical experimental session lasted for one hour. During that hour the subject sat with as few movements of the body and legs as were consonant with comfort, and recorded each fetal movement in a notebook held on her lap. For each movement, each of three variables was reported:

1. The time. The notebook in which data were recorded consisted of lined paper. One line was assigned to each minute of the experimental hour. A clock stood in front of the subject, so that a glance at the time of a fetal movement would show the minute in which that movement occurred.

2. The position. The abdomen was considered divided into three horizontal strips: upper, central and lower, and three vertical strips: left, center and right, making nine sections in all. A movement occurring in the upper left corner was recorded as UL, in the center on the left side as L, in the lower left corner as LL, etc.

3. The intensity. At first a particularly strong movement was designated by S after the record of position, as ULS, and a particularly faint movement by F. Later each movement was given a number, as LC2, showing the strength of the movement on a five-point scale. An extremely strong movement was given 5; the normal strength for movements observed outside of the experimental session was assigned 3; and 1 designated the movements which were so faint that it was questionable whether or not they should be recorded.

For each session, a record was kept of the date and of the conditions preceding the session. This record was very brief; it might consist, for example, only of "8/13 Active - tired." Any gross body movement, such as a sneeze, which occurred during the session was recorded at the time at which it occurred. Examination of the data when the experiment was completed showed that such movements seemed to have no effect on fetal activity; they were therefore disregarded in the preparation of tables.

The experiment was continued from the twenty-third week of fetal

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life, approximately four weeks after movements were first felt, to the thirty-first week, on the day before the babies were born. After fifteen sessions the data were tabulated and examined, and seemed to show an effect on fetal activity of maternal activity preceding the session. A change was accordingly introduced into the procedure: whenever possible a record was taken in the morning, before the subject got out of bed. During these sessions the subject was lying down, instead of sitting. In a few cases a further change was introduced. After a one-hour session in bed, the subject would be active for either thirty or sixty minutes, then lie down in bed as before and record movements for another hour.

RESULTS

As was to be expected, fetal activity increased with fetal age. The slight drop in activity which has been reported for the tenth month (3) could not, of course, appear here. The relevant data are summarized in Table 1, but there are clearly too few records to give a smooth curve, of which the formula and constants could be found.

The most interesting findings of the experiment are indicated in Table 2, which analyzes the experimental sessions according to the degree of maternal activity which preceded them. Because the five categories of activity were not spaced evenly during the eight weeks of the experiment, the number of kicks recorded was influenced by fetal age as well as by maternal activity (and of course by an unknown number of

TABLE 1

ACTIVITY IN RELATION TO APPROXIMATE FETAL AGE

Approximate fetal age in months	Number of Records	Mean number of movements per hour after activity
5½ - 6	10	77.3
6 - 6½	9	122.7
6½ - 7	8	166.1
7 - 7½	6	242.0

TABLE 2

PERCENTAGE OF FETAL MOVEMENTS AFTER DIFFERENT DEGREES OF MATERNAL ACTIVITY, FOR THE FIRST AND SECOND HALF HOURS OF THE EXPERIMENTAL HOUR

Degree of activity preceding session	Number of records	Percentage of fetal movements		
		First half hour	Second half hour	Total
Active	9	32.1	67.9	100.0
Moderately active	12	40.1	59.9	100.0
Mild activity	7	45.8	54.2	100.0
In bed, after a night's rest	9	50.7	49.3	100.0
30 or 60 minutes of continuous activity, just after rising	5	39.6	60.4	100.0

other factors). The data are therefore given not in terms of number of movements, but in percentages.

The first four categories, varying from fatigue to the basal condition, show an unmistakeable relation between maternal and fetal activity. Maternal activity or fatigue, according to these results, decreases the number of perceptible fetal movements which occur in the first half hour after such activity. Because of the nature of the experiment, which was so abruptly terminated, and because the author did not have access to other pregnant women who were willing to act as subjects, only the crude relationship described above has been demonstrated. Further experimentation is necessary to show: 1) whether the amount of work performed, or the maternal fatigue resulting from the work, determined fetal response; 2) the quantitative relation between the maternal and the fetal activity; 3) whether this relation varies during pregnancy; 4) the effect of length as well as degree of maternal activity; 5) the effect of different types of activity, using different muscles.

A more detailed analysis of the experimental hour confirms the difference shown in Table 2. If the first three and the fifth categories of that table are lumped together, in contrast to the fourth, we can compare the hour after normal waking activity with the last hour of a normal night's rest. This comparison is shown in Table 3.

In Table 3 is shown the erratic distribution of fetal movements during the hour after prolonged maternal rest, as opposed to the hour after maternal activity. In the latter case, the number of fetal movements is small during the first five or ten minutes of the hour, and increases gradually for about 30 minutes, when it seems to reach its maximum.

Because of incomplete planning of the experiment, the records immediately following sleep were taken at later periods of pregnancy than many of the records after waking activity. Thus another factor is introduced:

TABLE 3

MEDIAN NUMBER OF FETAL MOVEMENTS AFTER WAKING ACTIVITY AND AFTER SLEEP, IN FIVE MINUTE INTERVALS

Time in minutes	Median Number of Fetal Movements		
	after waking* activity	after sleep	After waking** activity
0- 4.9	5	13	6
5- 9.9	6	24	10
10-14.9	8	18	10
15-19.9	8	15	10
20-24.9	9	22	16
25-29.9	10	21	20
30-34.9	11	17	18
35-39.9	11	20	14
40-44.9	12	21	24
45-44.9	15	23	19
50-54.9	10	17	17
55-59.9	12	22	13
Number of records:	33	9	9

*unselected **records paired by dates with records taken after sleep

the absolute increase in number of fetal movements. So that this factor should not obscure the results, nine records of waking activity were selected, to be paired with the nine records taken after sleep. Choice was made only on the basis of close similarity of dates. These records show approximately the same trend as the total number of records after waking activity, and approximately the same absolute number of fetal movements for the second half of the experimental hour as do the records taken after sleep.

A curious difference between these data and those of Richards, Newberry and Fallgatter lies in the number of fetal movements reported. The unit of the other investigators was the number of ten minute periods in which any fetal movement was recorded. This unit is much too gross to be useful in the present report; even in the earlier records, taken at about 5½ months of fetal life, there was no ten minute period without movement. In the later records, there were few cases of even a single minute without movement. Three explanations of this difference are suggested: 1) The presence of twins may more than double the number of fetal movements, since the embryos may stimulate each other. If this factor is operative, it would be especially influential in the present case, since there was only one chorion; 2) An unusually large quantity of amniotic fluid was present. Because of this, movements may have been made more readily than under normal conditions of less fluid and more fetus. The fluid, acting as a sounding board, may have transmitted otherwise imperceptible movements; 3) A trained observer, such as the author, may have been able to record movements that were not noticeable to untrained women engaged in reading, manicuring, conversing and other activities.

In taking similar records during her present pregnancy, the author hopes to be able to obtain a check on the first two hypotheses. Examination of the data gives some highly inferential evidence in support of the third, which will be described below.

During the latter portion of the experiment, each movement was classified as to intensity on a scale of one to five, where three was of the strength usually observed outside of the experimental session, that is, when the author was not in bed, but was engaged in activity which could be expected to take the greater part of her attention. (The subjects of Richards, Newberry and Fallgatter were in bed, but engaged in comparable activity.) It might be expected that the distribution of intensities of fetal movement would fall roughly into a normal distribution, centered about three. This is far from the case. As is shown in Table 4, only fourteen or fifteen per cent of the total number of observed movements fall into the three highest classes. Now if the number of movements recorded here is divided in half, because in this case there were two fetuses; and reduced further by some unknown factor to allow for the first two unconfirmed hypotheses mentioned above, and if then about fourteen per cent be taken of the total, in case the subjects of the other experiment reported only the more noticeable movements, the discrepancy between those figures and these can be accounted for.

A word of apology should be added here, because of the inevitable difficulties of observation. As in every quantitative study, the qualitative differences which have been disregarded make the data both less

TABLE 4

NUMBER OF FETAL MOVEMENTS AS STRONG AS, OR STRONGER THAN THE MOVEMENTS NORMALLY OBSERVED, COMPARED WITH THE TOTAL NUMBER OF FETAL MOVEMENTS

	Number of records	Fetal Movements			
		Categories 3,4,5		Total	
		Mean	Per cent	Mean	Per cent
After activity	17				
First half hour		10.2	14.7	69.4	100.0
Second half hour		22.8	18.3	124.6	100.0
Total		33.0	17.0	194.0	100.0
After rest	9				
First half hour		18.5	13.4	137.8	100.0
Second half hour		13.4	11.5	116.4	100.0
Total		31.9	12.5	254.2	100.0

accurate and less complete than a set of tables would imply. For example, there were occasional times during the latter months of the experiment when the fetal movements, instead of forming a series of discrete kicks, could best be described as a ripple. How should that be recorded? Temporally, it was the equivalent of three or four kicks; spatially, of one or two; and qualitatively, it was only one movement. Usually the experimenter would compromise by recording it spatially, that is, if the ripple moved from the center to the right side, by calling it two movements: one at the center, one at the right. Such qualitative variations were recorded, but disregarded in tabulation; probably many interesting aspects of the material have thus been omitted from the report.

DISCUSSION

The major finding of this experiment, a decrease in fetal movements following a period of maternal activity, might not readily have been predicted, yet it is not inconsistent with facts already known. Carmichael (1) describes increased fetal movements when the blood supply of the umbilical cord is clamped off, and attributes these movements to the fetal oxygen shortage, which resulted from interference with the blood supply. Preyer (2) tells us that "in general the muscular movement, body work and moderate, slow walking must be designated, for this reason alone, as advantageous to the fetus, that thereby the entire circulation of the blood, as well as that of the uterus, is accelerated, and particularly through the muscular contraction the venous discharge of the blood in the heart and the ventilation of the lungs are favored."

Thus we have two items of information: maternal activity increases the fetal oxygen supply, and a decreased fetal supply of oxygen often makes the fetus more active. It does not seem unreasonable to induce that the converse of the latter statement is also true; and that, as in this research, maternal activity, which causes the fetus to receive more oxygen, is therefore followed by a period of relative fetal quiescence.

SUMMARY

From approximately five and one-half to seven and one-quarter months of pregnancy, the author recorded the location, intensity and number of fetal movements occurring during one hour. There were forty-two such experimental hours, thirty-three of which followed normal waking activity, and nine of which followed a night's sleep.

The number of fetal movements per hour increased during pregnancy. The number of fetal movements was consistently greater than had been reported by previous investigators. Several explanations are offered.

There was an inverse relation between the degree of maternal activity preceding the session, and the number of fetal movements during the session. Following maternal activity, the number of fetal movements was smallest during the first five minutes, gradually increasing until after about thirty minutes there were approximately as many movements as after sleep. It is suggested that the decrease in fetal activity after maternal exercise, is due to the increased supply of oxygen available to the fetus at that time.

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DAILY VARIATIONS IN THE BREATHING CAPACITY AND GRIP STRENGTH OF PRESCHOOL CHILDREN AS RELATED TO THE OCCURRENCE OF COLDS

ELEANOR METHENY[1]

Medical interest in the degree to which the breathing capacity[2] and grip strength of the individual is related to his health status is not a recent development. Literally hundreds of studies on this problem have appeared during the last century. Excellent reviews of the clinical literature on breathing capacity have been presented by Myers (5), by Lemon (3), and more recently by Thomas (7). Metheny (4) has summarized the material on both grip strength and breathing capacity as they relate to children ten years of age and younger. In the main, the studies to date have been based either on single measurements of breathing capacity or grip strength, or on measurements of these variables taken at rather widely spaced intervals. It is the purpose of this study to investigate the relationships which may exist between daily changes in grip strength and breathing capacity and the daily health status of the individual.

Three previous studies suggested that such an investigation might be fruitful. Arnett and Kornblum (2) reported that the daily measurement of breathing capacity is an adjunct to other clinical measures in visualizing the course of pneumonia. Arnett (1) obtained daily readings of breathing capacity for cases of pneumonia, spontaneous pneumothorax, and cardiac decompensation. He found that breathing capacity tended to decrease when body temperature rose, and to rise again when the temperature returned to normal. Rogers (6, p. 45) found that "grip strength alone responds remarkably well to changes in general physical condition." He tested the grip strength of one adult male subject daily for a period of six months and found that the grip strength records fell preceding an attack of "la grippe" and during periods of intense fatigue and nervous strain.

The subjects of the present investigation were twenty-two four-year-old children in attendance at the preschool laboratories of the Iowa Child Welfare Research Station during the school year 1939-40. Twenty of them were tested on each school day from November 15 to December 15, 1939, and all twenty-two were tested on each school day from January 3 to February 23, 1940.

Grip strength was tested with a small dynamometer of the Smedley type. This instrument was designed for use with preschool children and carried, as a motivating device, a picture of a duck which revolved to create the illusion of the duck eating corn. The instrument weighed .34 kg. and the handle could be adjusted to accommodate a grip as narrow as 2.5 cm. It was scaled in half kilograms and was accurate over the range of 1 to 22 kg.

Breathing capacity was measured with a small spirometer having a capacity of 150 cu. in. This instrument was also designed especially

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[2]*The terms breathing capacity, vital capacity, and lung capacity have been used interchangeably in the literature for many years. Throughout this paper the term breathing capacity has been used except in direct quotations from the literature.*

for use with preschool children. The spirometer and the dynamometer are described in detail in the monograph by Metheny (4).

In the preschool laboratories of the Iowa Child Welfare Research Station each child must be examined by the nurse before he is permitted to enter his group for the day. The grip strength and breathing capacity tests were added to the examination routine and were made immediately after the nurse's inspection before the parent took the child to the school building. Since the children did not arrive at evenly spaced intervals, there were sometimes from three to five children and the accompanying adults waiting at one time. This made it impossible to devote very much time to any one child.

For the November-December testing, each child was given two trials for breathing capacity and two for grip strength with the right hand. For the January-February testing, two trials were given as before, but if the best score made in either test was less than the average of the scores made for that test on the two preceding days, a third trial was given. Only the best score made in each test was recorded for each day.

No quantitative measure of degree of "health" was available. The sole criterion was preschool attendance. If a child was at school it was evidence that he had been approved for that day by the preschool nurse. If a child was absent, the reason for that absence was determined by the preschool nurse and reported in writing. These records were further supplemented by information obtained from each parent on Monday morning as to the health of the child over the week-end.

During the period of the investigation there were no serious illnesses in the group. Since the weather was severe during the period of the investigation, and since influenza and colds were common in Iowa City during these winter months, there were many colds and a few cases reported as "flu." It seemed impossible from the available information to make any reliable differentiation among the different kinds and degrees of respiratory infection. For this reason, the categorical term "colds" has been used to describe all illnesses characterized by some type of infection of the upper respiratory tract.

The data consisted of the daily records of grip strength and breathing capacity, and detailed absence records for each child over the period covered by the investigation. In analyzing these data a number of plans were considered. Those using deviations from some criterion scores seemed the most practicable. Using deviations for each test from mean scores over the entire four months' period was discarded, since some increase in score due to growth and possibly to practice over this length of time would tend to make such deviations positive at the end of the period and negative at the beginning of the period.

The method finally adopted was to compute for each child the deviation of each day's score from the average of the scores made on the two preceding days. This gave a daily picture of the child's scores in relation to the trend of his scores at that time. The following analysis is in terms of such deviations, negative deviations being termed "drops" and positive deviations "rises." The November-December data and the January-February data are analyzed separately because of the slight difference in the testing procedure for the two periods.

The preliminary analysis was made in terms of the number and magnitude

of "drops" for each of the tests. The scores made by each child the day before he was reported to have a cold, two days before he was reported to have a cold, and the day he returned after having been ill, were tabulated separately. All other scores were tabulated as "non-cold." This heading included all scores made more than two days before the incidence of a cold or more than one day after the child returned to school.

For both breathing capacity and grip strength, the frequency of "drops" and the magnitude of the "drops" were greater for the days preceding and following a cold than for the non-cold data. This suggested that it might be possible to "predict" colds one or two days before any overt symptoms were present on the basis of changes in grip strength and breathing capacity.

Since both breathing capacity and grip strength showed some relationship to the incidence of colds, it was thought that a combined criterion using both measures might be more useful than one based on either measure taken separately. The use of a combined criterion would also serve to eliminate some of the chance fluctuations which occurred in each of the measures. The following criteria were tried:

1. A drop of 2 cubic inches in breathing capacity and a drop of .2 kg. in grip strength occurring on the same day or on consecutive days.[3]
2. A drop of 2 cubic inches in breathing capacity and a drop of .5 kg. in grip strength occurring on the same day or on consecutive days.

A second set of criteria were also used which were based on simultaneous drops in both scores or a marked drop in the score of either test.

3. Drops of 2 cubic inches in breathing capacity and .5 kg. in grip strength occurring on the same day or consecutive days, OR a drop of 4 cubic inches in breathing capacity, OR a drop of .6 kg. in grip strength.
4. As in 3 above, except that .7 kg. in grip strength was used.
5. As in 3 above, except that .9 kg. in grip strength was used.

For each criterion the data for each child were examined and the number of times the criterion was equalled or exceeded was recorded. If a cold occurred within two days after the criterion combination was noted, the cold was considered to have been "predicted" by the drops in the scores of the tests. Colds which occurred independently of the criterion being used were considered as having been "not predicted." The success in "predicting" colds by each set of criterion scores is shown below. The number of possible predictions for the November-December data was 223, for the January-February data 368.

[3] *The average grip strength of these children was approximately 10 kg. Thus a drop of .2 kg. equals about 2 per cent, .4 kg. equals about 4 per cent, etc.*
The average breathing capacity of these children was approximately 60 cu. in. Thus a drop of 2 cu. in. equals about 3.3 per cent, 4 cu. in. equals about 6.7 per cent, etc.

	Cold Occurred[4]		No Cold Occurred	
	Cold Predicted	No Cold Predicted	Cold Predicted	No Cold Predicted
Criterion 1				
Nov.-Dec.	18	9	34	162
Jan.-Feb.	17	16	53	282
Criterion 2				
Nov.-Dec.	14	13	24	172
Jan.-Feb.	13	20	38	297
Criterion 3				
Nov.-Dec.	25	2	51	145
Jan.-Feb.	30	7	79	252
Criterion 4				
Nov.-Dec.	25	2	49	147
Jan.-Feb.	29	8	80	251
Criterion 5				
Nov.-Dec.	22	5	43	153
Jan.-Feb.	26	11	71	260

The degree of success with which each criterion predicts colds may be more easily determined if the figures given in the preceding tabulation are reduced to the per cent of cases meeting the criterion and developing colds within the following two days, and the per cent of cases not meeting the criterion which develop colds within the following two days. These percentages are shown below:

	Per Cent of Cases Meeting Criterion which Developed Colds		Per Cent of Cases Not Meeting Criterion which Developed Colds	
Criterion:	Nov.-Dec.	Jan.-Feb.	Nov.-Dec.	Jan.-Feb.
1	34.7	24.3	5.3	5.4
2	38.9	26.6	7.0	6.3
3	32.7	27.5	1.4	2.7
4	33.8	26.6	1.4	3.2
5	33.9	26.9	3.2	4.6

The comparison of percentages given above provides two estimates of the efficiency of the various criteria in predicting the occurrence of colds. The first is a measure of success: Of the colds predicted, how many actually occurred? From the first two columns of the preceding tabulation it may be seen that the success of the criteria varies, but that all indicate that the investigator using them could expect to be correct between one-fourth and one-third of the time. The second is a measure of failure: How often will a cold occur which has not been predicted

[4]*The total of colds is not the same for all criteria because no data were available for the week-ends. Thus, colds occurring on Tuesday or Sunday could be used only if the criteria were fulfilled by the scores made on Monday or Friday since two consecutive days' scores were not available.*

by the criterion? From the last two columns it will be seen that only a very small per cent of the cases which do not meet these criteria develop colds.

The χ^2 test was applied to the data from the tabulation above. For each of the criteria the results differed significantly (at the 1 per cent level of confidence) from those which would be expected by chance alone.

A further estimate of the degree of relationship between the prediction of colds by these criteria and the occurrence of colds was made by computing the tetrachoric correlations from the data used in the χ^2 tables. These are shown below:

Criterion	Tetrachoric correlations Nov.-Dec.	Jan.-Feb.
1	.62	.56
2	.60	.54
3	.80	.69
4	.81	.69
5	.75	.58

To be able to state that a child will have a cold two days before any symptoms are visible and to be correct one-third of the time may not seem a very significant accomplishment to the adult who usually knows when he is "getting a cold." But to do it with a test which takes less than a minute to administer, for four-year-old children who are not yet aware of the symptoms which precede a cold, suggests that these tests may have possibilities for use in the practical school situation. The fact that the prediction is fulfilled only one-third of the time must also be considered in the light of the fact that an adult may "feel a cold coming on" one day and find that the symptoms have disappeared the following day after a night's rest.

It is not the purpose of this paper to suggest that the tests actually measure the presence of an infection of the upper respiratory tract. It is more likely that they measure a general fatigued condition. When such a condition is present, the child is probably more susceptible to infection. Since the present investigation was made during a time when colds and influenza were prevalent, it may well be that the percentage of children developing colds following fatigue was much greater than it would be during a different period of the year.

From the present study it does not seem defensible to draw any very definite conclusions as to the usefulness of the tests of breathing capacity and grip strength in predicting colds in all situations. The findings do suggest, however, that some relationship between the tests and the occurrence of colds exists, and that the tests merit further investigation under a wider range of conditions.

It is suggested that the tests should be tried out in some institutional situation where the environmental conditions are relatively stable for all children and where the tests could be administered seven days a week. In such a situation the investigator could personally record the occurrence of colds for each child and thus be free from dependence upon reports of parents as to when a cold existed, when it started, its nature, and the possible sources of exposure.

If further investigations confirm the results of the present study it is suggested that the tests might have a practical usefulness in school and institutional situations. To test all children every day throughout the school year would probably be unnecessary. But if the tests were used during times of influenza or cold epidemics, it might be possible to reduce the amount of illness among the children tested. If a child's test scores were low for a given day, the parents or adults in charge of the child might be informed and additional rest and other precautionary measures suggested for a day or two. What the result of such a procedure would be in reducing the incidence of colds among the children can, of course, be determined only by investigation.

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